NSW GOVERNMENT | Department of Primary Industries

Industry insights- Poultry

Supporting document

NSW DPI Schools Program

Answer guide

www.dpi.nsw.gov.au

connect • grow • learn
DPI in SCHOOLS

Author: Meg Dunford (Project Officer School programs, NSW DPI Orange).

Editors and Advisors: Michelle Fifield (Education Officer Schools, NSW DPI Orange) and Jo Hathway (Project Officer School programs, NSW DPI Tocal College) and David Brouwer (NSW DPI, Tocal).

Disclaimer: This resource is produced for use by teachers and students. The information contained in this resource is based on knowledge and understanding at the time of writing (April 2023). However, because of advances in knowledge and technology, users are reminded of the need to ensure that the information upon which they rely is up to date and to check the currency of the information. To the extent permitted by law, the Department of Primary Industries within Regional NSW excludes all liability for any direct or indirect losses, damages, costs or expenses, incurred by, or arising by reason of, any person using or relying on this document (in part or in whole) and any information or material contained in it. Recognising that some of the information in this document is provided by third parties, the Crown in right of the State of New South Wales acting through the Department of Primary Industries within Regional NSW, the author and the publisher take no responsibility for the accuracy, currency, reliability and correctness of any information included in the document provided by third parties. Department of Primary Industries within Regional NSW expressly disclaims responsibility for any error in, or omission from, this report arising from, or in connection, with any of the assumptions being incorrect or otherwise.

Copyright
© The Crown in right of the State of New South Wales acting through the Department of Primary Industries within Regional NSW 2023, except where indicated otherwise. This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International (CC BY-NC 4.0). Under this license the material is available for free use and adaption. Educators may use, share, adapt, and republish material from the resource. You must give appropriate credit, provide a link to the licence, and indicate if changes were made. You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.

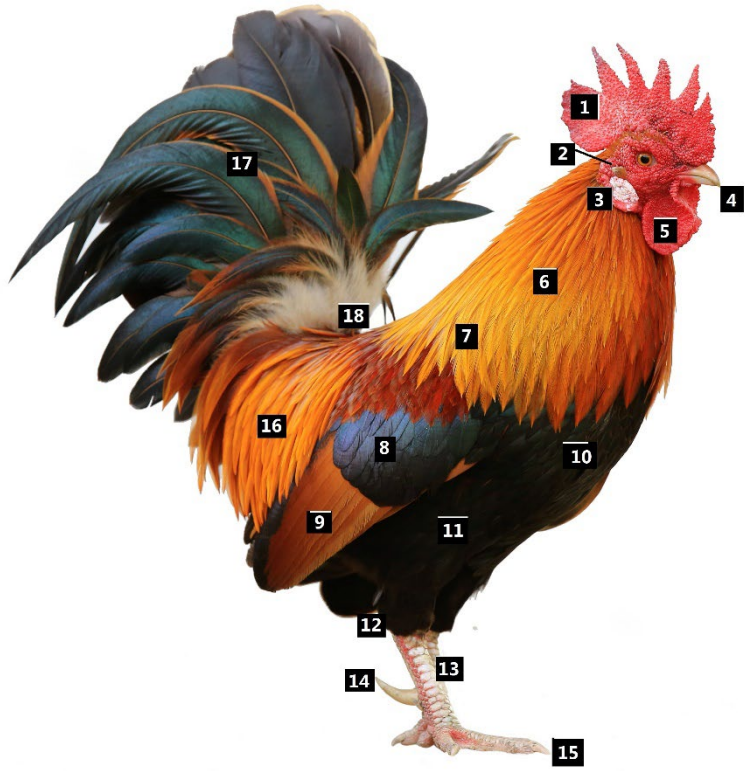
Table of Contents

Industry insights- Poultry answer guide

Sample answers have been provided for learning activities where applicable for this document. The following suggested answers should be used as a guide. It should be noted that these sample answers are suggested answers and not necessarily the very best answer, nor are they the only possible answers.

Chicken anatomy

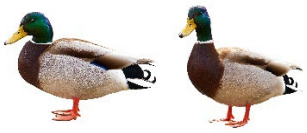
1. Label the parts of the chicken using the NSW DPI Schools Program 'Poultry' poster.



1. Comb	7. Shoulder	13. Shank
2. Ear	8. Secondary feathers	14. Spur
3. Ear lobe	9. Primary, flight feathers	15. Claws
4. Beak	10. Breast	16. Saddle feathers (male); cushion feathers (female)
5. Wattles	11. Thigh	17. Sickle feathers (male); main tail (female)
6. Hackle (male); cape (female)	12. Hock	18. Back

Poultry species and chicken breeds

1. Identify the poultry species in the following table. Where possible name the breed.

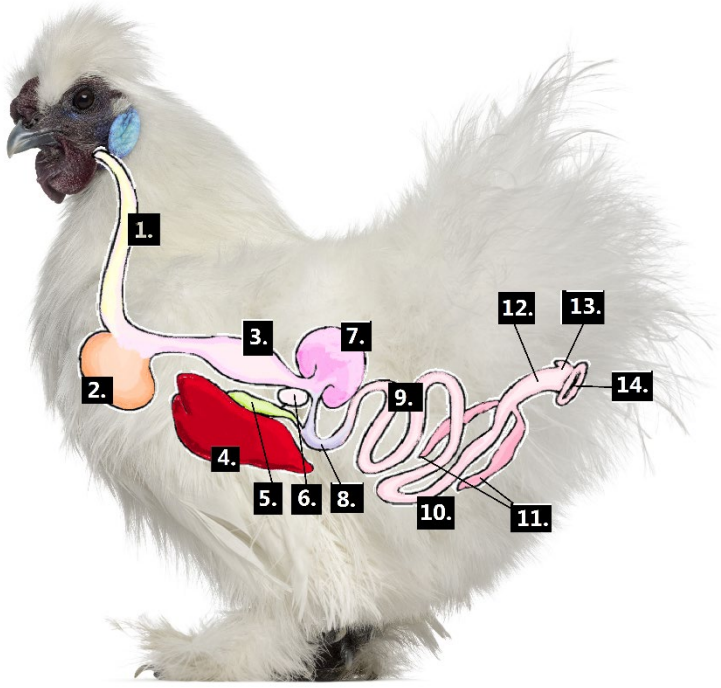
Poultry species			
	Pigeon (young meat pigeons are called squabs)		Mallard ducks
	Ostrich		Guinea fowl
	Goose (Geese= plural)		Emu
	Muscovy duck		Pheasant
	Turkey		Doves or pigeons
	Indian runner duck		Quail

2. Are pure bred chickens used in commercial poultry production? Why or why not?
   Purebreds are not used for commercial production. In the broiler and layer industries, hybrid birds have been selectively bred specifically for either egg production or meat production. Pure breeds do not have the high production rates compared to the selectively hybrid birds, so are not used in the commercial industries.

3. Label the chicken breeds using the NSW DPI Schools Program 'Poultry' poster.

Chicken breeds			
	Australorp		Plymouth rock
	White leghorn		Buff Brahma
	Rhode Island Red		Chinese Silkie
	Australian game		Modern game bantam
	Light Sussex		New Hampshire red
	Red Jungle fowl (*Gallus gallus*)		Silver- laced Wyandotte
	Ancona		Frizzle bantam
	Polish		Barnevelder

Poultry digestive anatomy



1. Label the hen's digestive tract using the NSW DPI Schools Program 'Poultry' poster.

1. Oesophagus	8. Duodenum
2. Crop	9. Small intestine
3. Proventriculus	10. Large intestine
4. Liver	11. Ceca
5. Spleen	12. Colon
6. Gall bladder	13. Cloaca
7. Gizzard (ventriculus)	14. Vent

Poultry digestive physiology

1. Complete the table to summarise information about the chicken's digestive tract. The first example has been given.

Organ	Description	Function	Identify the digestion type where applicable
Beak	• Mouth with no teeth. • Salivary glands connect to the mouth. • Connects to oesophagus	• Picks up food particles and directs the food into the oesophagus • Saliva added here which contains the enzyme amylase which breaks down carbohydrates	Chemical
Oesophagus	Muscular tube connecting the beak to the crop	Carries food from the mouth (beak) to the crop	N/A
Crop	A pear-shaped sac	The crop stores food before further digestion commences. The crop constantly releases food particles allowing for continuous digestion.	N/A
Proventriculus	• Glandular stomach • Small, muscular tube. • Glands connect to the proventriculus which secrete enzymes that chemically digest and break down food into available nutrients. Its main function is to carryout chemical digestion and transfer digesta from the crop to the gizzard.	Carries out chemical digestion and transfers digesta from the crop to the gizzard. Chemicals secreted in the proventriculus include: o Hydrochloric acid which lowers the pH of the food and digestive tract, o Pepsin- breaks down protein o Hormone gastrin- stimulates the production and release of gastric juices	Chemical
Gizzard	Flat, round, muscular organ containing grit or sand.	• The gizzard mimics the physical breakdown of food which is carried out by teeth in monogastric and ruminant animals. • The grinding action reduces the size of food particles, which increases chemical digestion of food into available nutrients.	Physical
Small intestine	Small, long tube connecting the gizzard to the caeca and large intestine. The pancreatic and bile ducts open into the small intestine at the end of the duodenum.	The majority of digestion and absorption in the bird occurs here. Fats, carbohydrates and protein are all digested here.	Chemical
Duodenum	• Part of the small intestine. • The duodenum is a long loop starting at the gizzard. It is closely surrounded by blood vessels and lymphatic tissue	Aids in absorption of nutrients and fluid.	Chemical
Caeca	Two, large 'blind sacs' at the point where the small intestine joins the large intestine.	Caeca function as absorptive organs and maintain 'gut health'. Caeca contain bacteria and microflora which have a limited capacity to break down some fibre from plants, through fermentation.	Microbial

Large intestine	Short tube connecting the small intestine to the cloaca and vent.	The primary function is absorption of water.	N/A
Cloaca	Common opening connecting urinary, digestive and reproductive tracts to the vent.	The urine, faeces as well as eggs or sperm from the reproductive system all exit through the cloaca.	N/A
Vent	Exit point for digestive system, urinary system and reproductive system.	Waste and undigested food are mixed with urine in the cloaca and eliminated from the body as faeces through the vent.	N/A

Poultry Nutrition

1. List the 6 nutrients essential for poultry.
   Water, carbohydrates, protein, fats, vitamins and minerals.
2. Complete the table to summarise information about poultry nutritional requirements. The first example has been given.

Nutrient	Why is the nutrient required?	Food sources the nutrient is found in.
Water	Water is required for all chemical processes in the body.	Water should be clean, fresh and always available. Small amounts can come from food.
Carbohydrates	Carbohydrates contain high amounts of energy. They are required for normal body maintenance and activity.	Cereals such as wheat, barley, maize, oats and sorghum.
Proteins	Proteins are required for growth, replacement of old cells and production of eggs, muscle and feathers.	High protein feed sources include fishmeal, oilseeds (such as soybean meal and sunflower seed meal), peas and lupins.
Fats	Proteins are an energy source that improve palatability of food and contain fat soluble vitamins. They are required for body maintenance as they are the basic unit of many hormones produced by the bird.	Feed sources high in fats include oils such as canola oil, linseed oil, sunflower oil as well or grains such as maize, sunflower, linseed and soybean.
Vitamins	Vitamins are required in very small amounts but are essential to chemical processes taking place in the body, as well as normal growth. Vitamins are either fat soluble or water soluble.	Vitamin A is found in carotene in green plants. Vitamin D is provided by sunlight and from plant material which has dried in the sun. Vitamin E is found in green plants and grain.
Minerals	Minerals are required in small amounts and are essential for a wide range of body functions, growth and development. Examples are calcium and phosphorus, which are needed for eggshell formation; correct bone growth and structure; and a range of other bodily functions.	Calcium can be provided as limestone (calcium carbonate). Phosphorus is provided in grains like maize, barley and soybean.

Go to the NSW DPI Poultry feeding and nutrition page to listen to the podcast 'Myth of hormones in chicken' and answer questions 9-16. (Follow this link for the podcast transcript)

3. Are hormones used in the poultry meat industry?
   No
4. When was the use of hormones banned in the chicken meat industry?
   1960s
5. What percent of consumers have the misconception and think that hormones are still used in poultry production?
   76% of consumers

6. List a reason why consumers still think hormones are used.
   Consumers do not understand that genetics control the natural productivity and growth of birds which are ready for consumption in 6-7 weeks.

   Consumers see advertising from other industries, for example the beef industry with campaigns advertising hormone-free beef. A lack of understanding leads to consumers assuming all meat industries therefore must use growth hormones.

7. List the three factors which drive chicken growth.
   Genetics (intense animal breeding programs), nutrition (intense animal nutrition) and environment (exceptional housing for birds).

8. Explain why short generation intervals have rapidly improved chicken genetics.
   Chickens have a short generation interval:

   - 21 days to hatch a chicken,
   - a pullet reaches puberty and is able to lay at 18-21 weeks old
   - a hen can produce 300 chicks in a lifetime.

   As a result, intense selective pressure on desirable characteristics in offspring, coupled with chicken short generation interval has resulted with quick genetic improvement.

9. Why is a well formulated feed important for optimal growth and production?
   A well formulated and high-quality chicken diet helps chickens reach their genetic potential which provides fast and efficient growth rates. This optimises production.

10. List environmental factors that are intensely monitored to optimise production.
    Temperature, humidity, air quality, lighting, water quality and ventilation are all painstakingly monitored and adjusted to provide birds the very best conditions to grow in.

Factors affecting the nutrient requirements of poultry

11. List eight factors which affect poultry nutritional requirements.
    Genetics, age, sex, reproductive state, temperature, housing system, health status and production focus.

Rations for birds at different growth stages

12. Why do starter chickens have a higher protein requirement than growers and layers?
    Chicks require a diet that will provide the nutrients needed for rapid growth and feather development. Chicks are given quite high levels of energy, protein and necessary vitamins and minerals throughout the starter period (0-6 weeks). Protein is the basic building block of bones, muscles, nerves, skin, blood cells and feathers. As the chick is actively growing it has much higher protein requirements. Once the chicks are fully feathered their energy and protein requirements reduce.

13. Explain why mature layers are provided ad lib shell grit and limestone, compared to growers and starter chicks which are not provided shell grit and limestone?
    The aim of layer diets is to optimise:

    - egg production (in terms of egg numbers, egg size or egg mass),
    - meet nutritional required to safeguard health and
    - maintain the desired body weight.

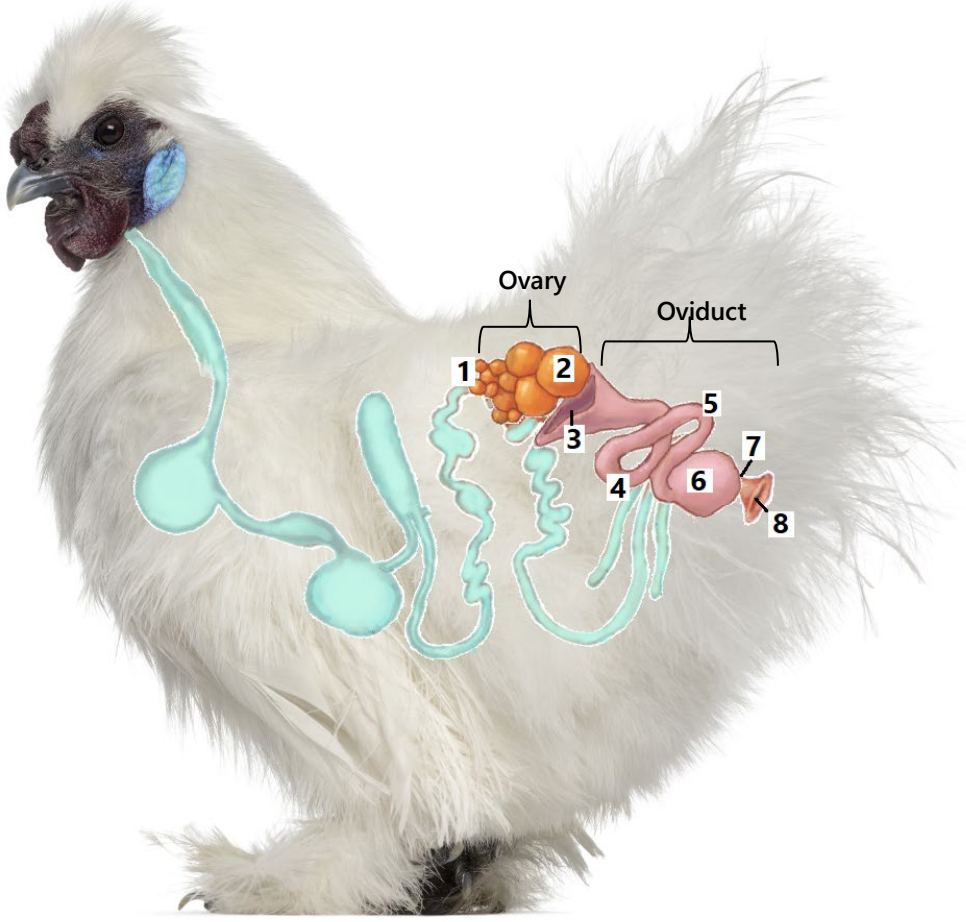
    Calcium is required for egg shell formation. Shell grit and limestone are high in calcium and are provided in increased quantities to form good quality shells. Shell grit also helps aid the bird's digestive system to break down food in the gizzard.

14. The following table shows feed analysis for three different poultry rations. Complete the table by identifying which layer growth stage each feed would be most appropriate for. Then explain why it is appropriate for that growth stage.

Feed name	Feed 1	Feed 2	Feed 3
Ingredients	Wheat, triticale, barley, oats, peas, lupins, lentils, beans, soybean, canola, sunflower and products derived from these ingredients. Meat meal, blood meal, fat, limestone, di-calcium phosphate, sodium bicarbonate, bentonite, salt, lysine, methionine, threonine, tryptophan, antioxidant, egg yolk pigments and enzymes. Shell grit. Vitamins and minerals premix.	Wheat, triticale, barley, oats, peas, lupins, lentils, beans, soybean, canola, sunflower and products derived from these ingredients. Meat meal, fish meal, blood meal, fat, limestone, di-calcium phosphate, potassium carbonate, sodium bicarbonate, salt, lysine, methionine, threonine, tryptophan, antioxidant, and enzymes. Vitamins and minerals premix.	Wheat, triticale, barley, oats, peas, lupins, lentils, beans, soybean, canola, sunflower and products derived from these ingredients. Meat meal, fish meal, blood meal, fat, molasses, limestone, di-calcium phosphate, salt, lysine, methionine, threonine, tryptophan, antioxidant and enzymes. Bran and pollard. Vitamins and minerals premix
Feed analysis	Protein (min) 17% Fat (min) 3% Calcium (min) 4% Fibre (max) 8% Linoleic acid (min) 1.2% Salt (max added) 0.35%	Protein (min) 23% Fat (min) 5% Fibre (max) 6.5% Salt (max added) 0.35%	Protein (min) 16% Fat (min) 5% Fibre (max) 10% Linoleic acid (min) 1.3% Salt (max) 0.35% 0.35%
Which layer growth stage?	Layer	Starter	Grower
Why is it appropriate?	• Correct protein (17%) • High calcium (4%) from limestone as required for laying eggs • Shell grit for correct digestive function in gizzard and calcium requirements for egg laying.	• Correct/high protein (23%) • High fat (5%)	• Correct protein (16%) • High fibre 10% from bran and pollard • High fat (5%)

Poultry reproductive anatomy

1. Label the hen's reproductive system using the NSW DPI Schools Program 'Poultry' poster.



1. Developing ova	5. Isthmus
2. Mature ovum	6. Shell gland
3. Infundibulum	7. Cloaca
4. Magnum	8. Vent

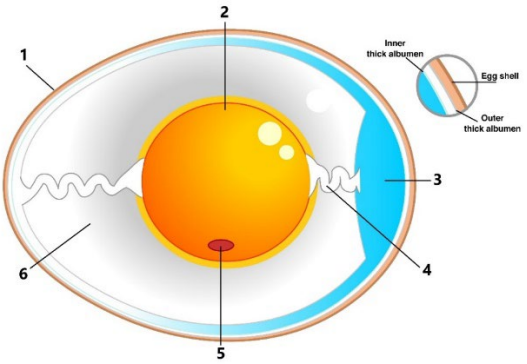
Poultry reproductive physiology

1. Complete the table by matching the avian reproductive organs to their function. Use the NSW DPI Schools Program 'Poultry' poster.

Reproductive organ	Function
Vagina / Cloaca	Egg passes through as it is laid
Isthmus	10% albumen laid down; shell membrane laid downs; shape of egg determined
Uterus (shell gland)	Remaining 40% of albumen added; shell formed; pigment of cuticle laid down
Infundibulum	Picks up yolk. Site of fertilisation.
Magnum	40-50% of albumen laid down (egg white)

Chicken reproduction facts

2. Label the parts of the egg using the NSW DPI Schools Program 'Poultry' poster.



Parts of the egg	
1 Shell	4 Chalazae
2 Yolk	5 Germinal disc (blastoderm)
3 Air cell	6 Albumen (white)

3. Describe how the hen's environment can be managed and altered to increase laying.
   Increase the hours of light to between 14-16 hours by providing artificial light, for example in a roosting or laying shed.

4. The layer industry produces eggs for human consumption. All eggs for human consumption from commercial layer farms are unfertilised. Roosters are not run with layer hens. Explain why roosters are not run with hens in commercial layer enterprises? Use the internet to help with your answer.
   Layer hens are not run with roosters at commercial layer farms, because hens running with roosters go 'broody' and want to sit on a clutch of eggs. Broody hens stop laying, which reduces hen productivity. Commercial layer farms do not keep roosters; instead they acquire day old sexed female chicks from a hatchery and breeder facility.

5. Chickens are seasonal Polyestrous breeders. Use the internet to create a definition for a seasonal Polyestrous breeder.
   Polyestrous refers to an animal's ability to have several oestrous cycles per year.

   Seasonal breeders or non-continuous breeders breed and mate throughout the year at certain times which are dependant on environmental factors such as season, daylength (photoperiod) and temperature.

   Chickens are seasonal Polyestrous animals that rely on changes in photoperiod (hours of light) to time reproduction. Typically, an increase in photoperiod to a point (14-16 hours) increases reproduction, whereas a decrease in photoperiod will stop laying. This means, that under natural daylight conditions, a hen almost never lays after 3:00 p.m. If a hen ovulates/lays an egg too late in the day, the next ovulation occurs the following day, and the hen has a day when it does not lay an egg (rest period between clutches). Photoperiod affects chickens clutch length, moult and sexual maturity.

6. What is the incubation period for a chicken?
   The incubation period for chickens is 21 days (breed dependent).
   - Watch 'Day by day chicken embryonic development' on YouTube to see real time foetal development of a chicken without a shell from day 3-19.
   - Go to Poultry Hub's 'Incubation' webpage to answer the following.
7. What is an incubator and what does it do?
   A machine which artificially provides the essential environmental requirements (temperature, turning, relative humidity and oxygen) that a hen naturally provides eggs, which is essential for embryo development.
8. List and describe the four essential environmental conditions which must be managed throughout artificial incubation.
   - Correct and even temperature controlled by a thermometer or thermocouple
   - Correct humidity controlled by ventilation rate and water application
   - Correct oxygen and carbon dioxide concentrations controlled by ventilation
   - Turning of the fertile eggs by approximately 90 degrees several times per day by manual or automatic means.
9. Complete the table to identify the incubation requirements for chickens.

Incubation requirements for chickens	
Incubation period (days)	21
Incubation temperature (°C)	37.6
Relative humidity (%)	56-62
Day number to stop turning eggs	18
Incubation temperature (last 3 days)	37.4
Relative humidity (last 3 days)	70-83

10. What is candling? When and why is it carried out?
    Candling is the process where eggs being incubated are held up to a light to see if they are fertilised and to look for weaknesses in the shell such as cracks or fractures. Fertilised eggs after days 5-8 will have blood vessels and a dark spot. Infertile eggs will be clear with no evidence of blood. Early embryonic death shows up as a blood ring surrounding the yolk. Candling can also be undertaken at 18 days of age, where the embryo is clearly visible with a distinct dividing line between the embryo and the air cell.

The following image shows an egg being candled.

11. A) Is this egg fertilised or unfertilised?
    Fertilised

    B) Approximately what day of incubation is the egg?
    Egg is approximately day 5-8 of incubation.

Watch 'Egg candling from day 1 to 21/egg hatching' to observe candling using a smartphone for the light source.

12. Complete the table to identify the effects of incubation failure on hatching

Incubator problem	Hatching characteristics
Incubation temperatures were too high.	Early hatched, weak chicks, unhealed navels, unabsorbed yolk sacs, crooked toes, crossed beaks and a high proportion late dead in the shell.
Incubation temperatures were too low	Late hatching of large soft chicks which are slow starting, and chicks with wry (crooked) necks.
Incubation humidity was too high.	Large numbers of unhatched, unpipped chicks, live trapped embryos and large chicks coated with albumen.
Relative humidity was too low.	Small weak chicks with large air cells, exhausted chicks in shells that have been chipped most of the way around, and chicks glued to the shell.

Go to Poultry Hub's 'The avian egg' webpage to answer questions 34-36.

13. How can eggs for consumption be enriched to be higher in minerals, antioxidants or omega-3 fatty acids and vitamins?
    It is possible to enrich eggs with minerals (e.g. iron and iodine), antioxidants (e.g. selenium, vitamin E) or omega-3 fatty acids and vitamins, by adding these components to the hen's diet.

14. Add the missing words to complete the passage.
    The egg contains all the nutrients that the developing chick needs during the three weeks of incubation period and for the first couple of days after hatch. Water vapour and gases such as oxygen and carbon dioxide are able to move across the egg shell through small openings called pores. The developing chick starts off as a single fertilised cell on the surface of the yolk and progressively grows, using up the yolk, some of the albumen and some calcium from the inside of the egg shell. In the final stages of development, the chick takes up the last bits of yolk into its own digestive system.

15. Complete the table to summarise what each component of the egg is made of and its function. The first example is provided.

Egg component	Composition	Function
Yolk	The yolk is comprised of 33% lipid, 17% protein, and small amounts of minerals, vitamins and carbohydrates.	The yolk provides lipids and proteins essential for embryonic growth.
Albumen	The albumen consists chiefly of proteins, including ovalbumin, ovotransferrin, ovomucoid, ovoglobulin, lysozyme and ovomucin	The albumen protects the embryo (or yolk) from attack by microorganisms and serves as a source of water, protein and minerals for the embryo
Egg shell	The eggshell consists of protein, Calcium carbonate, magnesium and phosphorus.	The egg shell provides a protective chamber encasing the yolk, albumen and developing embryo. The egg shell contains pores which allow for water vapour and gas exchange

Poultry pests, diseases and biosecurity

Watch "Poultry Meat Biosecurity, Chicken Meat Australia" to answer the following.

1. List the main ways contamination and pathogens can spread on poultry farms.
    - Contaminated people
    - Contaminated vehicles and equipment
    - Contaminated litter
    - Wild birds, rodents, feral animals, insects, livestock and domestic pets
    - Contaminated feed and water
    - Poultry movements including mortalities
    - Through the air

2. Describe three management strategies which reduce or prevent biosecurity threats on the farm.
    Answers will vary. Topics could include: Animal proof fences, biosecurity signage and locked entry gates, specific parking point for visitors, change area with sanitisation station and clean PPE away from poultry, sanitisation of equipment and vehicles entering property, vermin control plan, litter from low risk source, vegetation buffers and shelter belts, collect and remove dead or sick birds daily, constructing a biosecurity action plan, training staff etc.

Poultry health and diseases investigation

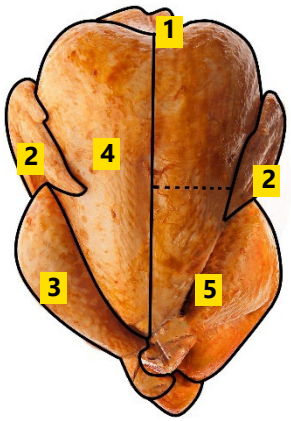
Instructions:

- ✓ Go to the NSW DPI, Poultry health and disease page
- ✓ Select a poultry disease to further research from the list (Avian influenza, Newcastle disease or Salmonella Enteritidis)
- ✓ For your chosen disease research and include the following:
  - Common name of disease
  - Identify the pathogen or causative agent. For example, bacteria, virus etc.
  - Explain how the disease spreads. List all vectors (spreading agents)
  - Explain the current situation in NSW and Australia (is the disease present or not)
  - Identify if the pathogen is zoonotic (spreads to humans)
  - Identify and describe ways the disease can be treated
  - Identify and describe ways the disease can be prevented
  - Explain how the disease could affect production in the poultry industry
- ✓ Compile your findings into a digital report; for example, a brochure or poultry disease fact sheet.

  Answers will vary

Contrasting Broiler and Layer production and markets

1. Use NSW DPI Schools Program 'Poultry' poster, to complete the table by naming the carcass location of the chicken and giving examples of poultry cuts.



Location	Carcass location	Poultry cuts
1	Neck	• Chicken necks
2	Wing	• Wing • Drumlette • Mid-joint wing (wingette) • Wing tip • Forequarter (breast and wings)
3	Leg	• Drumstick • Thigh fillet • Chicken chop
4	Breast	• Breast fillet (bone in or boneless) • Tenderloin
5	Leg quarter with backbone	• Maryland with backbone • Maryland fillet
	Other	• Diced chicken • Stirfry and casserole strips • Mince • Liver • Heart • Giblet • Feet • Tail

2. List the main raw product/s from the layer and industry. Eggs
3. List the main raw product/s from the broiler industry. Chicken meat
4. List 5 value added products from the layer industry. Answers will vary
5. List 5 value added products from the broiler industry. Answers will vary
6. List the breed/s used for the layer and industry.
   Hybrids ISA brown, HISEX, and Hy-line brown
7. List the breed/s used for the broiler industry.
   Ross x Cobb hybrids

8. Compare commercial layer production systems

Cage-

- Only used in the layer industry
- Highly intensive production system- all food and water and environmental conditions are managed
- Chickens do not roam
- Highly efficient system in terms of productivity
- High population of birds/area
- High inputs of labour and management
- Controversial animal welfare outcomes

Cage production is the most intensive of the layer production systems and has highest production efficiency. Birds are continuously caged throughout production. Birds are replaced annually before moulting. Moulting sees a decline in production. Light is often supplemented 15-16 hours per day to maximise productivity. The animal welfare outcomes cause consumer concern. However, the industry is highly legislated to provide high minimum requirements for welfare. Large scale production.

Barn-

- Highly intensive production system- all food and water and environmental conditions are managed
- Chickens can freely roam around the barn and exhibit natural behaviours such as dust bathing, scratching, roosting, nesting etc.
- Highly efficient system in terms of productivity, but not as efficient as cage system. Egg losses through egg breakage and birds laying out of nesting boxes
- Birds can be bullied or injured from other birds (pecking order)
- High population of birds/area, but not as high as cage system
- High inputs of labour and management
- Controversial animal welfare outcomes

Cage production is the second most intensive of the layer production system. Birds are reared in a barn (shed) throughout production. Layers are kept in batches while they are productive. Batches are replaced annually before birds moult. Between batches, barns are cleaned out, litter replaced in preparation for another batch. Large scale production.

Barn systems can be used in conjunction with free range. The barn doors open throughout the day (weather dependant) allowing hens to choose to remain in the barn or free range outdoors.

Free range-

- Semi intensive production system- food and water provided as well as access to free range pastures.
- Environmental conditions are managed to varying degrees from no infrastructure e.g. temperature, light, rain, wind etc to infrastructure that could be small scale chook tractor to large scale access to barn system
- Chickens can freely roam around and exhibit natural behaviours such as dust bathing, scratching, roosting, nesting etc.
- Reduced productivity compared to cage and barn systems. Egg losses through egg breakage and birds laying out of nesting boxes in paddocks
- Birds can be bullied or injured from other birds (pecking order)
- Higher risk of predation and pest/disease transmission

- High population of birds/area (not as high as cage or barn system)
- High inputs of labour and management
- Animal welfare considered higher than cage systems.

Free range production is semi-intensive compared to cage and barn systems. Birds always have access to free range pastures to graze. Layers are kept in batches while they are productive. Shelter must be provided to hens at night for protection from predation. Systems can range from small to large scale production. Free range can be used in conjunction with barn systems.

9. Broilers process out (yield) at approximately 70% dressed weight.
Dressing percentage = (carcass weight ÷liveweight) ×100
Use this equation to fill to calculate answers and complete the table for the broiler domestic market specifications.

Market	Live weight (kg)	Carcass weight (kg)	Dressing percentage
Take-away market birds	1.6-1.7kg		70%
Bagged whole birds		1.54kg	70%
Deboned products	2.9-3.4kg		70%

Market	Live weight (kg)	Carcass weight (kg)	Dressing percentage
Take-away market birds	1.6-1.7kg	1.12-1.19kg	70%
Bagged whole birds	2.2kg	1.54kg	70%
Deboned products	2.9-3.4kg	2.03 -2.38kg	70%

10. Use 'Export markets' data to list export destination for both NSW layer and NSW broiler industry products.
Philippines, Myanmar, Hong Kong and Vanuatu.

11. Identify a global area or continent that is important to both the NSW broiler and layer industry export markets. Explain why you think that particular area consumes large amounts of NSW primary industries products.
Asia and the South Pacific. Countries within this geographical area are major export markets and destination of NSW poultry products. The export markets have been secured for a variety of reasons including:

- NSW and Australian agriculture products are of high quality and free from most pests and diseases.
- Australia is geographically close to these destinations, which reduces costs of transport and also reduces time in transport which allows fresh, high-quality produce to be available quickly. Eggs and chicken meat are perishable products, so closeness to markets ensures product quality and freshness.
- The Australian government has developed trade agreements to secure export markets with countries in this region to assist our farmers and the Australian economy.

12. Explain why Australian poultry meat and egg exports and new markets have grown over the last couple of years (Hint: think of biosecurity).
Export of both Australian chicken meat and eggs have increased over the past couple of years with the opening of new market export destinations. This is because avian influenza (bird flu) has affected poultry production in Asia, Europe and the United States, which are major poultry producers. Australia remains free of bird flu.

13. Define vertical integration
    Vertical integration is a marketing and production strategy where a producer owns and controls multiple aspects in a marketing chain. This gives greater control of production.
14. Evaluate free range production vs barn or cage production for either the broiler or layer industry. Evaluate each system in terms of:
    - Production efficiency
    - Management
    - Animal welfare

    Answers will vary

Measuring finances - poultry production

1. Calculate the gross margins for a small-scale layer enterprise and a small-scale broiler enterprise.

A) Layer production sample gross margin (small-scale)			
Background: Birds are purchased at 18 weeks of age and sold at 70 weeks of age (52 weeks of production). Selling 95 spent hens sold. Marketing: Organic, free-range eggs sold to niche markets. Enterprise: Layers Enterprise unit: 100-layer hens Mortality: 5% Production system- Organic barn/free range Size- 2 ha			
Income			
	Quantity	Price	Total ($)
Jumbo and extra-large eggs	820 (dozen)	$7.80/dozen	$6396
Large eggs	950 (dozen)	$8.00/dozen	$7600
Medium eggs	400 (dozen)	$7.80/dozen	$3120
Spent hens	95 hens	$1.00/head	$95
		(A) Total income	$17211
Variable costs			
	Quantity	Price	Total ($)
Pullets	100 hens	$7.50/head	$750
Feed- layer pellets	2200 kg	$640/tonne	$1408
Sawdust	6 bales	$105/bale	$630
Labour- broilers only	180 hours	$20/hour	$3600
Advertising/marketing	1 flock	$250/flock	$250
Egg collecting and packaging	2170 dozen	$0.20/dozen	$434
Labour (collecting and packaging)	60 hrs	$18/hour	$1080
		(B) Total variable costs	$8152
		(C) Gross Margin = (A-B)	$9059
		Gross margin/ bird	$90.59/bird
		Gross margin/ unit area	$4529.50/ha

B) Broiler production sample gross margin (small-scale)			
Background: 100 birds reared. Birds are housed as day-old chicks and slaughtered and sold at 8 weeks of age. Slaughtering and selling 85 birds. Average 2.2kg dressed weight Enterprise: Broilers Enterprise unit: 100 broilers Marketing: Barn/free-range birds sold to niche markets. Mortality: 5% Production system- barn/free range Size 3ha			
Income			
	Quantity	Price	Total
Bird sales	272kg	$18.00/kg	$1462
Manure/spent litter	1800kg	$80	$80
		(A) Total income	$4976
Variable costs			
	Quantity	Price	Total
Chicks	100 chicks	$4.00/head	$400
Feed- Starter	220kg	$0.98/kg	$215.6
Feed- Finisher	280kg	$580/tonne	$162.40
Sawdust	3 bales	$105/bale	$315
Labour- broilers only	22 hours	$20/hour	$440
Marketing/advertising	1 flock	$180/flock	$180
Pasture maintenance	1 flock	$50/flock	$50
		(B) Total variable costs	$1763
		(C) Gross Margin = (A-B)	$3213
		Gross margin/ bird	$32.13
		Gross margin/ unit area	$1071/ha

2. Identify which production enterprise is more profitable in terms of the gross margin?
   The layer production system is more profitable with Gross Margin =$9059; Gross margin/bird =$90.59/bird; Gross margin/unit area = $4529.50/ha.
3. The broiler production system produces five batches of broilers each year. The layer system produces one batch each year. Calculate and contrast the annual gross margin/unit area, for each system. Which is the most profitable in terms of the gross margin/annum?
   - Small scale broiler system- $1071/ha × 5 =$5355/ha annually
   - Small scale layer system- $4529.50/ha × 1 = $4529.50/ha annually

   The small-scale broiler enterprise comparatively has a greater gross margin/ha annually.

Current and emerging technologies

1. Select a poultry industry-specific technology from the list above. Use the internet to compile a 1- 2-page report on your selected technology.
   Your report should include:
   - Name of the technology
   - Images of the technology
   - Thorough description of how the technology works
   - Description of how the technology is used to improve production efficiency
   - A table contrasting the advantages and disadvantages associated with using the technology

   Answers will vary.

Poultry careers

1. Use the internet and other sources to investigate a poultry industry-related career of your choosing. For this career find out the following:
   - Title of the career/job
   - Role description
   - Personal qualities
   - Skills required (if formal courses or education is required, find out where you could train and the timeframe to complete the course)
   - Salary or wage range
   - Identify opportunities for job progression in the role

   Useful sites to help you with your research include:
   - Free range chicken farming- Yarra Farm New South Wales
   - A day in the life of a chicken meat farmer
   - Carers in Poultry- Poultry Hub Australia
   - 14 Careers in the Poultry Industry With Duties and Wages

   Answers will vary.