SOUTH AFRICAN POULTRY ASSOCIATION
SUID-AFRIKAANSE PLUIMVEEVERENIGING

Learning Module 3 layers

Nutrition, water, ventilation and record keeping

These notes were compiled by Professor James Hayes on behalf of the South African Poultry Association and are the property of the South African Poultry Association.
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Nutrition, Environmental Control and Role of Water

Introduction

The cost of feed is by far the largest portion of the production cost of eggs; the efficient use of feed by the hen will therefore determine to what extent a layer operation will be successful. For example say the total cost to produce 1 eggs amounts to R10/dozen then the cost of only the feed alone will be R7.00. Factors that cause feed not being used by the bird to produce an egg, for example a low level of disease, will lead to an increase in feed cost because the hen had eaten some feed that day but without producing an egg.

The purpose with the information in this chapter is to enable you to have an understanding of the following:

- What must be provided by feed so that the hen can produce at an optimal rate.
- To provide and manage conditions that has a positive effect on egg production, for example ideal house temperatures or healthy flocks.

Nutrients the hen needs from the feed

Nutrients	Function of the nutrient
Proteins from: oil cake meals for example soya and sunflower	Proteins consist of chains of amino acids. During digestion these chains are broken up to free the amino acids. These can then be absorbed and used for the formation of egg proteins. Egg proteins the best and most complete source of protein for young children.
Energy mainly from maize and other feedstuffs.	Starch in maize digested to glucose. Glucose a universal source of energy for : Movement; Chemical reactions to form egg proteins, Shell formation; Heart contractions to pump blood; Respiration; Feather formation, the list is endless .
Calcium from limestone and phosphorus from rock phosphate.	Mainly calcium from limestone crumbs or grit, for maintenance of the skeleton and egg shell formation. An egg shell contains 2g of calcium. Other minerals such a phosphorus, manganese, zinc, sodium, potassium, etc.required in very small quantities in cell reactions.
Vitamins and minerals added in pure form as a premix	Most important functions as facilitators in cell reactions. Cells are the building blocks of organs in the body. Vitamins and minerals are usually added to the feed as a fine powder that easily separates from the coarser particles. Hens prefer coarse particles and powdery material is not well consumed. Important that feed troughs should be emptied by the hens before new feed is added. When feed becomes wet from leaking feed bins or in the feed troughs, mould (fungi) will grow in the feed and use all the vitamins for their own growth so that egg production is depressed.

Some examples to show the effect of vitamin deficiencies in feed.

Crooked breastbone due to vitamin D deficiency in feed

Bleeding in brains removed from birds with vitamin E deficiency in the feed

Figure 1. Left: Crooked breastbone due to vitamin D deficiency. Right: Symptoms of vitamin E deficiency in a hen, note the bleeding in brains removed from hens showing vitamin E deficiency symptoms.

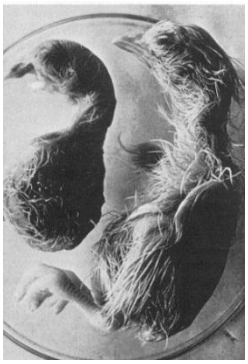


Figure 2.Embryos without legs due to zinc deficiency. On the right is a hen with deformation of the leg and slipped hock tendon, this condition is known as perosisand is the result of a manganese deficiency in the feed.

Fungus under enlargement

Lumps of feed due to fungus growth in a feed bin that was not properly sealed against rain water.

Figure 3 Mould growth inside

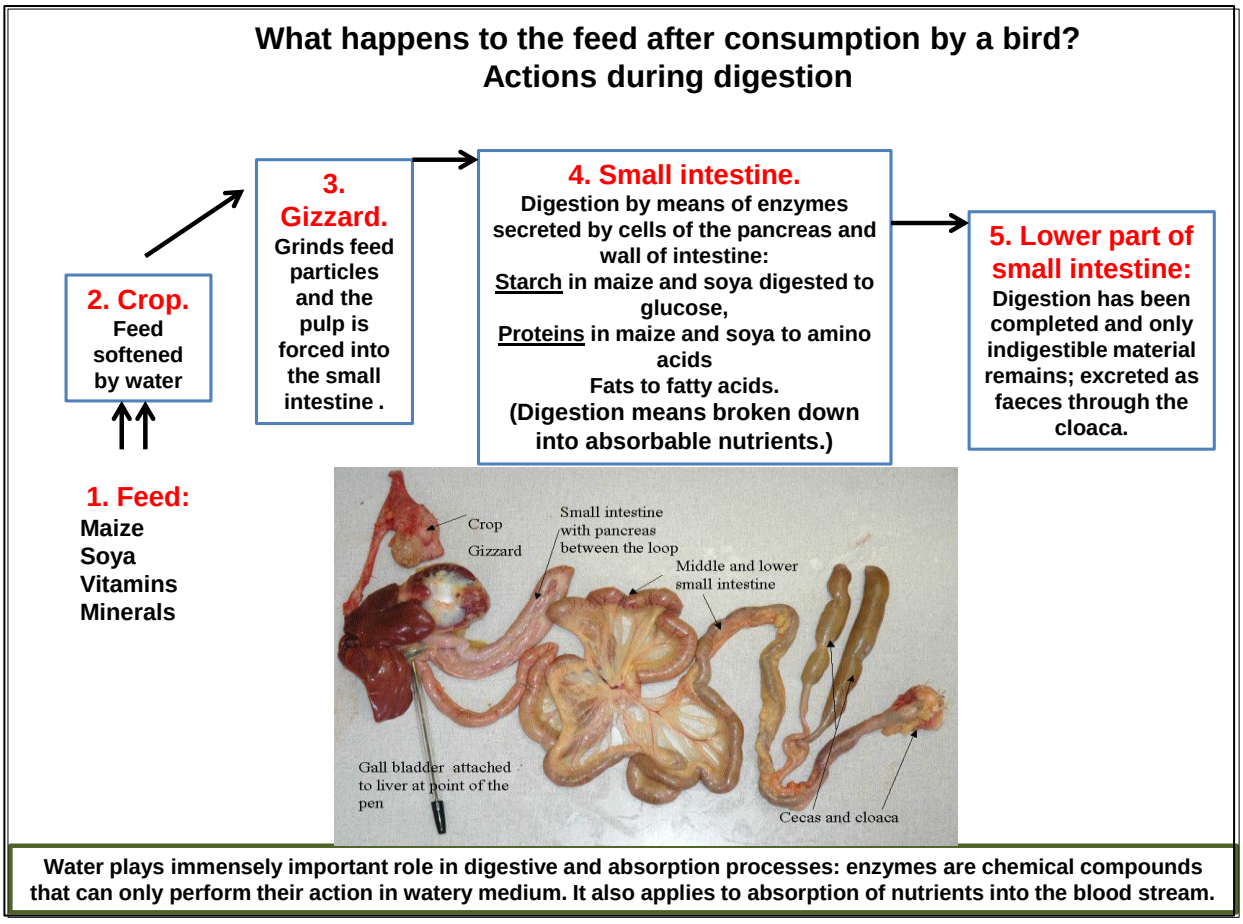
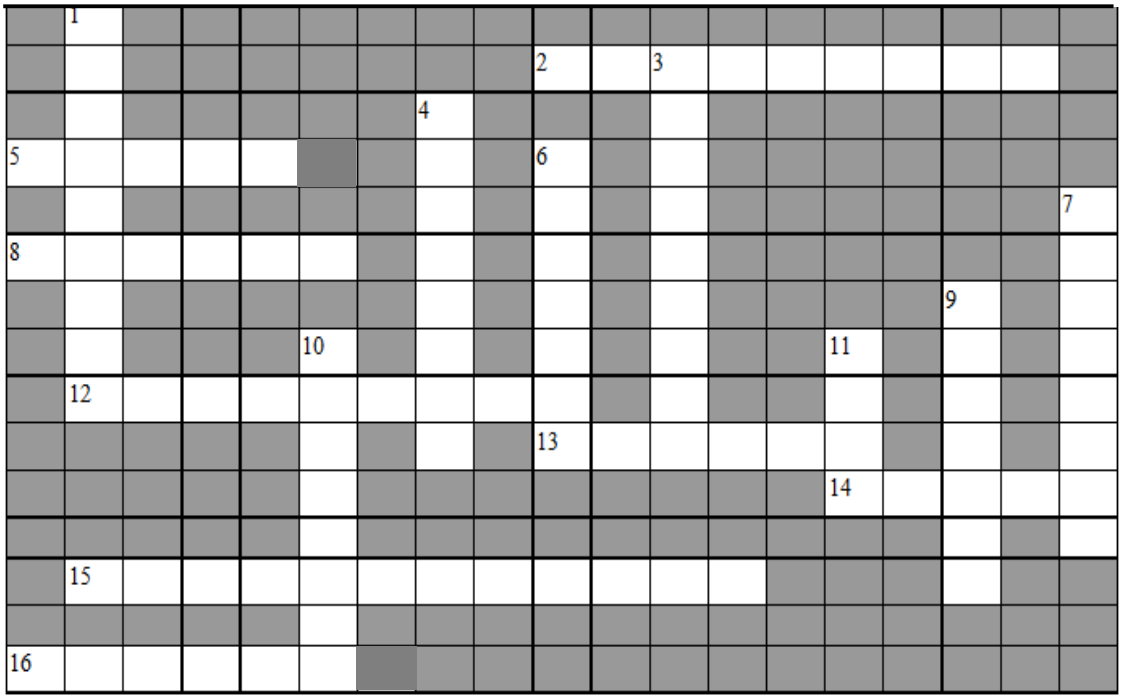


Figure 4 The digestive process in hens

The end products of digestion, namely glucose, amino acids and fatty acids are absorbed into the blood stream that flows through the small intestine and carried to the various organs for utilization by the cells of those organs.

Test your memory challenge number 1 Nutrients and digestion



Clue Across	Clue Down	
	1	The process by which feed is broken up to make the nutrients available
	3	The mineral that is needed by the hen to prevent bone deformation, a condition known as perosis.
	4	Substances in body tissues that consist of chains of amino acids
	6	The nutrient that can be utilized by the hen as source of energy.
	7	A framework of bones that needs calcium for its maintenance
	9	This nutrient is a mineral and utilized in the formation of strong bones
	10	These nutrients are essential agents to facilitate chemical reactions inside body cells
	11	The oil cake meal from these beans is an important source of proteins for hens
2		This product is added as a source of calcium in hen diets.
5		The building blocks of organs in the body
8		This substance is made by plants and renders glucose after digestion
12		The general term that is used for the substances after digestion of feed in the small intestine.
13		The driving force for chemical reactions and obtained from the combustion of glucose.
14		These acids are the end products of protein digestion
15		A person at the feed mill that does the formulation of poultry diets
16		Another word to describe the size of limestone grit.

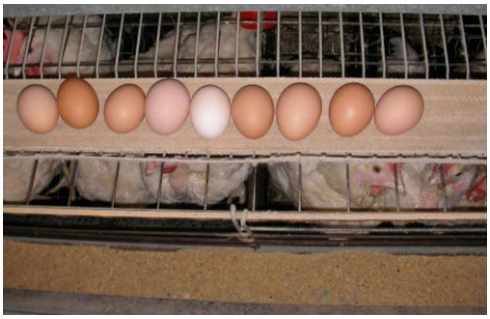
Role of environmental conditions on layers.

Environment includes the following aspects:

1. Temperature of the surrounding air in the laying house.
2. Moisture content of the surrounding air in the laying house.
3. Dust content of the surrounding air in the laying house.
4. Light intensity (illumination) in the laying house.
5. Ventilation (air movement).

Knowledge box

1. **The normal body temperature of the hen is 42ºC**
2. **This heat originates from actions such as:**
   Heart muscles pumping blood.
   Abdominal muscles contracting during respiration.
   Intestinal muscles contracting during digestion.
   Formation of eggs by chemical reactions in oviduct or the liver.
3. **All actions use glucose as energy source with heat being liberated.**



The effect of the surrounding air temperature on the comfort of layers

- Importance of a comfortable surrounding air temperature. Heat production by the hen is an on-going process while the bird is alive. Thus if heat is not lost at the same rate as being produced the body temperature of the hen will increase and the bird will die.
- At normal environmental temperatures, for example 25ºC, the bird is able to lose heat (mainly from the skin) to the surrounding air at the same rate as which it is being produced.
- At high environmental temperatures, more than 30 ºC, the body temperature will start to increase. This is because the air does not absorb heat fast enough to enable the hen to maintain a normal body temperature. The birds will start panting to lose heat by means of evaporative cooling from the respiratory tract. (More about this a little later).
- At low environmental temperatures the bird will lose more heat than what is being produced by the chemical reactions inside the body cells. Human beings will start shivering. It means some muscles are contracting and heat is being generated. The same happens in hens: although not clearly visible they shiver; they use glucose for those muscle contractions to obtain energy and feed intake creases. We know from experience that feed conversion is poor in winter because a lot of the energy is used for shivering during the cooler climate.

Effect of high temperatures on laying hens

It has been mentioned that at air temperatures of 30°Chens will start to pant. This is because their body temperature has started to increase beyond 42°C and the loss of heat from the body to the surrounding air is not fast enough.

Panting means they increase their respiratory rate to evaporate moisture on the wet surfaces of the mouth and the respiratory tract. Evaporation of moisture[1] from these surfaces results in their cooling and also of the blood in these tissues. The cooled blood returns to the inner body which is thus also cooled.

You can test the cooling effect that is brought about by evaporation of moisture by simply licking the back of your hand and to blow air over that part. You will feel the cooling effect for yourself!

Role of moisture in poultry husbandry

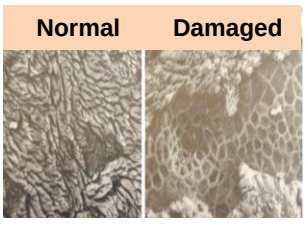
Role in ammonia formation in bedding
Role in body temperature regulation of hens

Ammonia formation in bedding

In free-range systems of egg production wet bedding can be problem in winter and especially if low temperatures are accompanied with rain, such as in the Western Cape. In wet bedding bacteria causes the development of ammonia. Ammonia is a gas that has serious negative effects on the wellbeing of hens and poultry in general, these include the following:

Ammonia causes skin burn under the feet of hens and this prevents them to visit feed and water lines. Egg production is negatively affected.

Ammonia causes cracks on the inner lining of the respiratory tract and makes it is easy for disease causing organisms to infect it.



Picture on left: Skin burn under the feet. Right: Normal and damaged lining, cilia, inside respiratory tract due to ammonia.

[1] One of the laws of physics states that when a liquid changes to a gas heat is absorbed from the surface of the liquid.

Origin of moisture in bedding:
Excreted in faeces and urine, water content, 80%.
Leaking water nipples can also make a big contribution. Replace leaking nipples as soon as possible.

Removal of moisture (water) from bedding and droppings
Water has to evaporate from bedding into the air and then ventilated. (It is the only way!).
Turning of bedding material (to *dol*) to expose the underlying material to air so that water can evaporate and the vapour taken up into the air and then removed by ventilation.
Factors determining the efficiency of evaporation of moisture from bedding

a) The temperature of the air inside the building. Cold air cannot hold a lot of moisture before it is saturated. (We all know that washing does not dry easily in winter.)
   In winter the problems of wet bedding (and thus high levels of ammonia in the air) is greater than in summer. It is important that curtains shall be positioned in such a manner that temperatures during the day or night do not drop so low that very little or no moisture is removed. A lot of time must therefore be spent to experiment and get the settings right.
b) The moisture content of the air outside the building. In those areas in the country of naturally high humidity it is difficult to remove a lot of moisture from bedding material. This is because the air has a limited ability at a particular temperature before becoming saturated[2] with moisture and only limited evaporation takes place.

High moisture in the air makes it difficult for hens to cool themselves in hot weather.
Hens start panting at temperatures of 30°C. This is because their body temperature had increased to above 42 °C. (Not enough heat could be given off to the environmental air.)
Cooling by means of evaporation of moisture from the wet surfaces of the mouth cavity with panting is not efficient when the moisture content in the air is high. The inhaled air becomes saturated with moisture and no evaporation (cooling) takes place.
Cooling environmental air by means of cooling pads: The efficiency of cooling by the cooling pads is also determined by the humidity of the outside air. The lower the moisture content, the more can evaporate and the lower the temperature will be of the air that enters the building through the cooling pad. With a high humidity in the air cooling is poor.

Dust content in the air of the laying house

High levels of dust in the air inside the laying house can have negative effects on layers. The dust accumulates on the wet linings inside the respiratory tract and bacteria on dust cause widespread infections not only in the respiratory tract but also inside the air sacs.

Dust can contain between 200 000 and 800 000 bacteria per gram of dust.

[2]Saturated means **filled to capacity**, further uptake has become impossible.

Inhaling large numbers of bacteria overwhelm the natural defence mechanism of the hen: Inside the air sacs ideal conditions of temperature, moisture and nutrients exist for their multiplication. Birds that are suffering from stress, such as a low level of a disease, for example IB, will be overwhelmed by *E. coli* bacteria and show symptoms as illustrated in the picture.

High dust levels in the building can be caused by under-ventilation:
1. Fan speeds or curtain openings have not been correctly set.
2. Fan belts that are slipping and not moving the correct amount of air.
3. Fan blades, cowls and louver openings covered with dust.

Effect of light on egg production

Light is a form of energy, it can penetrate the skull to stimulate a certain part of the brain to form hormones. Hormones are chemicals that are passed into the blood stream and stimulate the liver to start forming egg yolk material for deposition into the ova (the female reproductive cells).
Pullets are reared in light-tight buildings in which only nine hours of light is given to approximately 15 weeks of age. Thereafter the light program changes and the light periodis slowly increased. These increases in the number of hours of light stimulates the brain to produce hormones that lead to the deposition of yellow yolk material in the ova as shown in the picture.

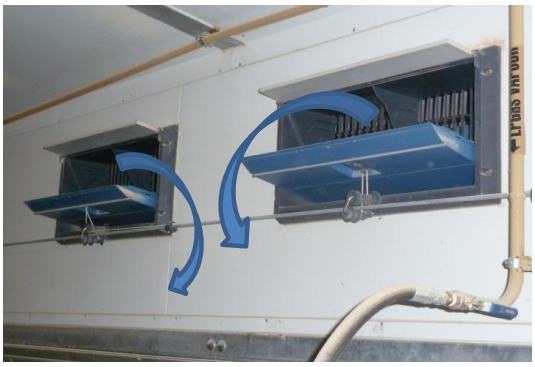
After placement in the laying cages the increase in light hours continues, to 14 or 15 hours, to ensure that birds reach peak production. An important aspect is the level of lighting. It can easily happen that if some light bulbs or fluorescent tubes are not working and that the distribution of light is uneven throughout the building. This affects production especially in birds in the bottom rows of battery cages. In a free-range system birds might move away from the darker areas to congregate in the brightly lit areas where bedding will become wet resulting in ammonia formation.

Ventilation

A. Patterns of air flow
Ventilation means movement of air through an opening, whether louvers or curtains. In mechanically ventilated houses fans will pull air out of the building and air from outside will enter the building through any opening to fill the space (vacuum).

The size of an opening determines the speed with which air will enter through that opening. For example if fans would be running at a particular setting, the speed with which air enters the building will be much higher with a small louver opening than with a large louver opening.

The speed of the air will determine the distance it will travel into the building, or height towards the ridge. Air that enters a building at a low speed will drop to the floor instead of moving upwards and mixing with air close to the ridge of the building, see Figure 5



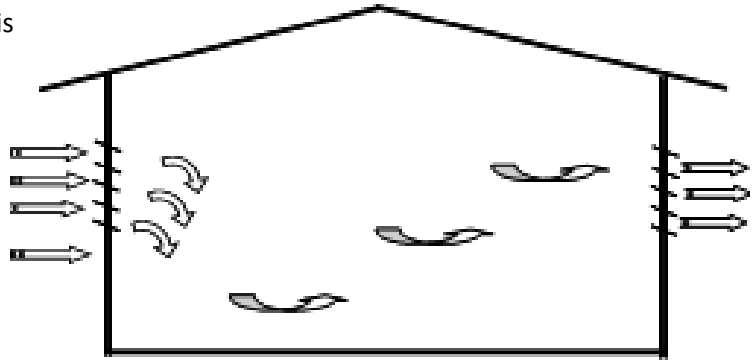
Low air speed. Cold air drops to the floor.

High air speed. Cold air mixes with hot air near ceiling.

Figure 5 Left: Low air speed, only one fan running. Right: High air speed with four fans running at full speed.

In houses with open sides and curtains, ventilation can only take place if wind is blowing.
The size of the curtain openings and the wind speed will determine the amount of air that will be replaced inside the building. If no wind is blowing there will be no ventilation!!
Most of these buildings have openings in the ridge of the roof through which hot air can move out due to natural convection of hot air that rises and the space is filled with cooler air.

In winter cold air dropping to the floor is especially a problem these houses where control over incoming air is difficult and cold and wet spots will be present close to the wall, direction of the wind is from the left.



Setting of curtain openings will depend on temperature and strength of the wind. With a strong cold wind the opening facing the wind will be small. At the other side the opening will be much larger. During hot weather curtains will obviously drop much larger to remove heat from the house. Pay regular visits after changes to curtains have been made to evaluate the situation.

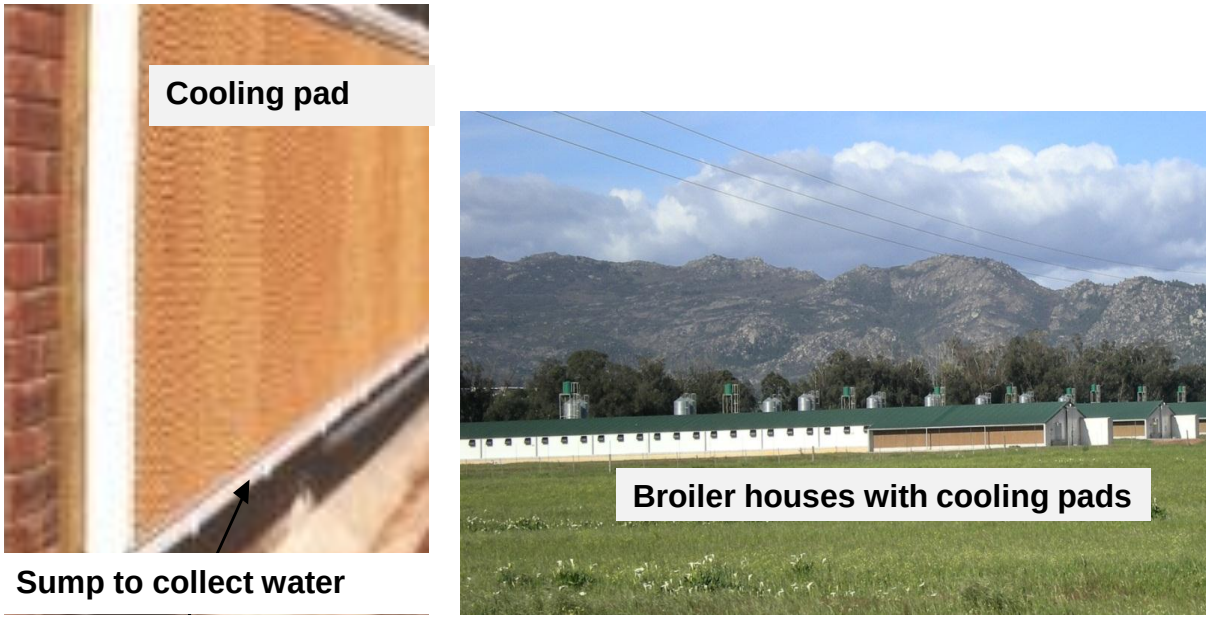


Figure 6 Left: Structure of a cooling pad. Right: Layer houses equipped with cooling pads on side.

B. Ventilation: Removal of heat and cooling of incoming air bmm

Heat from the hen's body will effectively be given off to the surrounding air if temperature differences are big enough, for example the hen at 42°C and house temperature at 25°C.

The flow of heat from the body of the hen to a house temperature of 35 °C, however, will be much less than at 25 °C, and the hen will start panting and lose body heat by means of evaporative cooling.

There is the belief that an increase in wind speed will have a cooling effect. However, it will only remove the exhaled moisture of panting and some heat in the immediate vicinity of the bird. It cannot cool the bird. If layers had had sweat glands, like humans, from which water could evaporate, then cooling could have taken place.

During high summer temperatures the only means to create comfortable conditions is to pass the air through a cooling pad, Figure 6. The cooling of the air through the cooling pad can amount to 6 – 8°C, which is brought about by the evaporation of the water on the cooling pad.

When water evaporates, it changes from a liquid to a gas, and during this process heat is taken up from the air, in other words, the air temperature drops by a few degrees.

Conditions for the bird has then improved and heat can again flow from the body of the bird to an air temperature of 29 °C (35 – 6).

The efficiency of cooling is determined by the following factors:

1. The humidity of the air before it passes through the cooling pad.

In those areas of the country where the relative humidity is normally high, for example 60%, the ability of such air to absorb a lot moisture is much **less** because it will become saturated sooner than that of air containing only 30% moisture. Less water can evaporate at 60% than at 30% and the cooling effect will thus be lower.

2. The size of the cooling pad and the coverage with water.

Large pad areas as opposed to smaller areas with pads will be more effective because more water can evaporate. The same applies to coverage with water, areas that are clogged and not wetted, decreases cooling.

3. Air speed through the cooling pad.

If the air speed is low, the cooling effect will be poor and temperatures close to the cooling pads might be comfortable. At the other end of the hen house, high temperatures will still prevail.
If the air speed is too high water droplets will be carried into the building and cooling will be poor.
The temperature of the water has no effect on the efficiency of cooling!

The role of water in poultry husbandry

Water can be regarded as one of the most important nutrients for poultry. Water is one of the four main components of the bird's body; more than 60% of the body mass is water. This means that a hen weighing 2000 grams consists of1200 g of water.

In the following paragraphs we shall be looking at:

1. Role of water in digestion, absorption and transport of nutrients.
2. Role of water in excretion of waste products.
3. Role of water in body temperature regulation.
4. The role of water in health management.
5. Signs of water shortage.

Role of water in digestion, absorption and transport of nutrients

The swallowing of feed and the movement of feed through the digestive tract is brought about by means of muscle contraction. However, it is only wet material that can be forced out of the crop and down the gastro-intestinal tract.
On right is the crop of a bird that had no access to water and it can clearly be seen that feed could not pass down to the gastro-intestinal tract to be digested[3].

The coarse contents of feed in the muscular stomach

[3]Digestion is the breaking up of starch and proteins in feed by means of enzymes into absorbable substances such as glucose and amino acids.

(gizzard) are clearly visible and show how the grinding action and digestive enzymes transformed it into watery slurry that passes into the small intestine.[1]

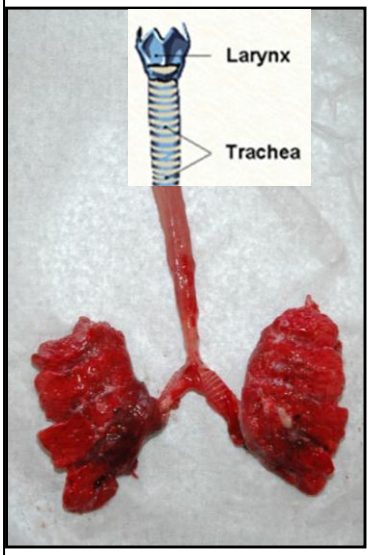
Starch and proteins in this slurry are broken down by enzymes to glucose and amino acids.
Glucose and amino acids are soluble in water and are taken up by the blood vessels and transported to the various body tissues:

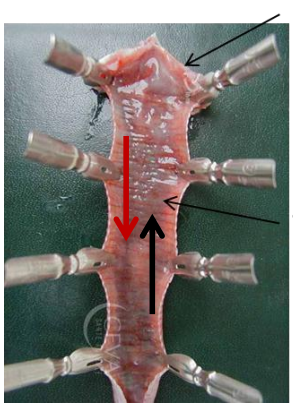
- Glucose is used as energy source.
- Amino acids are used by the cells to renew worn tissue or used by the liver cells to form egg yolk proteins and many other proteins in the body.

Role of water in body temperature regulation

During very hot weather humans will start sweating and the evaporation of the moisture from the skin results in cooling. The cooled blood in contact with the skin returns to the deep body and that helps the person to maintain a constant body temperature. Poultry however, have no sweat glands in the skin and they will start panting during environmental temperatures above 30 ºC. (Hens panting were illustrated in paragraph 0 on page 8.)The inner surface of the mouth and the wind pipe to the lungs are the main sites in which evaporation of moisture takes place. This is illustrated in Figure 7. Moisture evaporating from moist areas in the mouth cavity and the trachea results in cooling of those surfaces, and so also the blood serving those areas. Cooled blood returns to the inner body which lowers the temperature of the bird. One can say that this is comparable to sweating in humans and it has the same cooling effect as sweating.

Windpipe (trachea) and lungs





When <u>inhaling air</u> (red arrow) evaporation of moisture takes place on the <u>wet inner surface of the trachea.</u>
<u>Blood</u> in contact with the trachea <u>is cooled</u> and returns to body tissues and cools the bird.
Black arrow shows air leaving the body.

Figure 7 Respiratory system of the bird showing the area where evaporation of moisture on the trachea takes place[4]

The availability of good quality drinking water is of utmost importance during high temperatures when the hen loses a lot of moisture during panting. The water that moistens the inner surfaces of those areas are secreted by the cells in the linings of the mouth and the windpipe and is obtained from the blood stream.

In those areas of the country close to the sea, such as Durban, where the air contains a lot of moisture, the *relative humidity* is high, and the evaporation of sweat is not very efficient. The same applies to poultry. In areas of high humidity during hot summer days poultry are unable to cool themselves by means of panting. Evaporation of moisture from the respiratory tract is poor and not a lot of heat is thus removed from the blood serving these tissues.

The role of water in excretion of waste products: faeces and uric acid

Indigestible substances are the fibrous parts of plants such as the hulls of sunflower seeds or the cellulose layer that surrounds a maize kernel. Products that could not be digested are usually visible as the dark brown contents in the lower part of the small intestine. It has a watery consistency and is thus easily propelled by the muscle contractions of the intestines. In the cloaca a very large portion of the moisture is reabsorbed.

Faecal matter is not the only waste product that has to leave the body. Uric acid is a waste product from the many chemical reactions that take place in the body cells. It is insoluble and floats in the blood stream as small crystals, almost like fine sand. In the kidneys the uric acid crystals are filtered out and collected by the kidney tubes. It then requires a lot of water to be flushed out to the cloaca where most of the water is reabsorbed. The concentrated uric acid is excreted as that white cap on the faeces, see picture. Uric acid is degraded by bacteria in bedding material and is the source of ammonia in the air of the hen house.

The role of water in health management

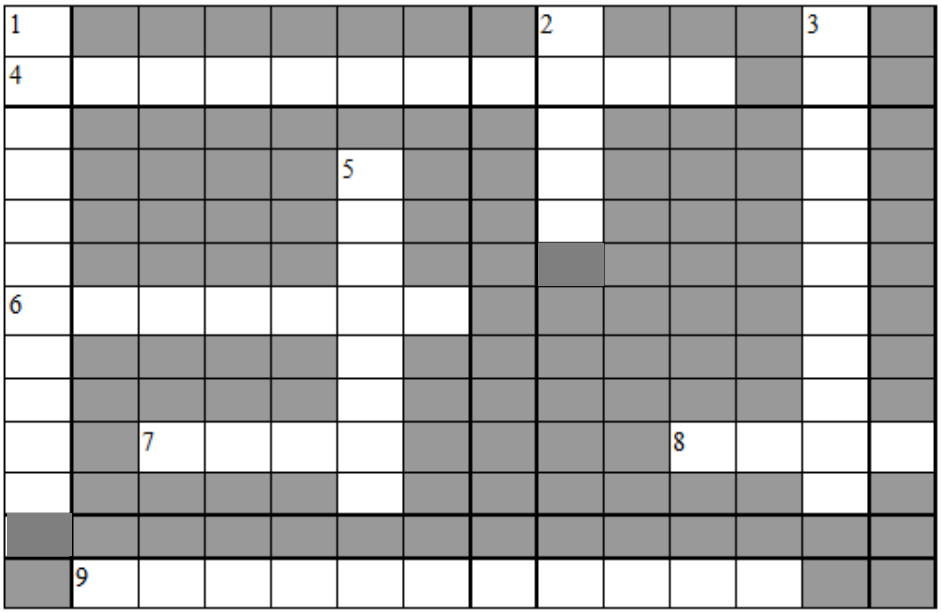
In paragraph0on page 8it was mentioned that the linings of the respiratory tract contains cells that secrete moisture. These cells have the form of tiny hair-like structures, called cilia, which are able to perform sweeping actions to remove bacteria that are inhaled. In birds that have limited access to drinking waterthe cilia will dry out and the sweeping actions will stop. Bacteria will accumulate on the surface of the respiratory tract and penetrate the underlying tissue to cause infections.

[4]Permission to use the CEVA pictures was kindly granted by prof I.Dinev, Faculty of Veterinary Medicine, Trakia University Bulgaria.

Signs of water shortage

Severely restricted intake of water leads to a condition known as dehydration. In such a situation the body cells have lost so much water that they became wrinkled, especially visible on the toes and legs in day-old pullets that have travelled for more than a day during very hot conditions. In chicks that have died the white spots of accumulated uric acid on the outer surface of the liver and kidneys are clearly visible.

Test your memory challenge number 2



Clue Across	Clue Down	Clues to answers
	1	The inner lining of the tract of this system is affected by ammonia gas
	2	Hair-like structures in the lining of the respiratory tract that remove dust and bacteria
	3	The word for movement of air through an opening
	5	The word that describes the moisture content of air
4		The process by which water changes from a liquid to a gas
6		Skin burn under the feet of layers is caused by this gas
7		This material in the air of the hen house contains bacteria that causes infections on the inner lining of the respiratory tract
8		The hen is able to store feed in this organ for digestion at night
9		A condition where body cells have lost a lot of moisture due to water shortage in drinker lines

Poor performance without obvious reasons

It might happen that hens just stop performing according breed standards without obvious reasons or visible shortcomings in the normal husbandry practices.

Under such circumstances it is useful to use the acronym FLAWSS as guideline for a systematic investigation for causes of such problems. FLAWSS stands for the following six factors: Feed, Light, Air, Water, Sanitation and Space. The procedure would be to look very closely at each of these factors and to establish whether conditions for each of them are in compliance with the norm and standards that are applicable to each.

Feed

Look carefully at the consistency and dustiness of the feed in the trough, is it in accordance to what it used to be or are there many more fines than usual. It is most important to know exactly what the feeding behaviour normally has been.

Taste and smell the feed and be sure that it is the same as it used to be with no traces of rancidity or change in colour. Feed is the most costly item in the production of eggs and it is of utmost importance to be able to identify any deviation that could lead to birds refusing to eat.

Light

It is most important that cages in the bottom rows are not too dark due to light bulbs or tubes not working. An even distribution of light in free-range houses is important to ensure an even distribution of hens throughout the house. Light bulbs or tubes not working must be replaced as soon as possible. Time switches must be inspected every day to ensure that their settings are correct.

Air

Air quality includes aspects such as temperature, dust, gases such as ammonia, moisture and carbon dioxide. The air quality is probably one of the most important factors that determine the comfort of birds in a poultry house and good ventilation is the only means by which changes can be brought about. In mechanically ventilated buildings dust on fans and louvers affects efficient air movement. Fan belts not tight enough results in insufficient air exchanges. In naturally ventilated buildings a lot of time should be spent on evaluating the behaviour of hens after ventilation settings have been adjusted. It is indeed also important to follow up with regular visits after changes have been made.

Water

The availability and quality of water is of overriding importance for high producing layers. An egg of 55g contains 36g of water which must be consumed over and above the normal quantity that is needed for digesting feed and excreting faeces and urine, which is twice the amount of feed consumed. This is under normal temperatures, during hot weather it increases dramatically.

Water nipples that do not deliver water due to blockages or that are sticky should be replaced immediately when noticed. Bacteria in water from contaminated water lines or water sources not chlorinated correctly can cause huge drops in egg production. Thus attention to ensure good water quality is most important.

Sanitation
Sanitary (clean) conditions means that less opportunity is available for disease causing organisms to multiply on dead birds, less opportunity for flies to carry viruses to the birds and less dirt that offer protection to bacteria and viruses.

There is thus less exposure to disease causing organisms.

Wet bedding in free-range houses cause unsanitary conditions: ammonia development and growth of mould that depress egg production.

Space
In free-range systems wet areas develop when curtain settings are too large and the temperature inside the house is cold and no moisture is removed. At night the birds avoid the cold areas and congregate in hotter areas which also become wet. Ammonia develops in those areas with all the negative consequences such as infections of the respiratory tract!
Bedding in wet spots should diligently be turned to expose the underlying wet material during the hot part of the day or removed and replaced with dry material.

Record keeping practices

Of all agricultural industries, poultry production can boast to be practiced on the highest scientific level than any of the other industries. The application of genetic principles to select outstanding poultry lines for meat or egg production, or the accurate formulation of feed based on chemical analysis of feedstuffs to formulate diets to meet the requirements of the different types of birds, are all proof of the science that goes into poultry farming practices.

The measurements that had been collected and expressed in figures formed the basis for the progress that has been achieved. In the following number of paragraphs it will be attempted illustrate the important role of measurements in the everyday poultry farming environment.

Calculating percentages and averages

Percentages
The word per cent means per hundred or per *century* shortened to per *cent*, indicated by %. (The word century is still in use, for example in cricket: “He scored a century (100 runs) during the first hour” or “For a century (hundred years) no murder has taken place in that little village”.

It is most important to express some results on the farmer 100 birds with other words in percentages. The following serve as an example:

A small scale farmer bought 200 day-old chicks and found 16 dead on the second day, it thus means eight per one hundred, i.e. Eight per cent.

His neighbour also had 16 deaths on the second day but he had bought400chicks, he therefore had a mortality of only 4 per cent, 4 per 100. He probably had a better brooding system and therefore the lower mortality per 100.

The reason for using percentages is to be able to make comparisons by using the same baseline.

The calculation of the figures in the aforementioned example was fairly easy: You first divide the number of mortalities, 8, by the total number of the flock placed then multiply by 100 to obtain the figure per 100, which gives the percentage.

A further illustration of the importance to express certain events in terms of percentages can be illustrated by comparing two houses with different numbers of layers:
House A was placed with 15 000 day-old broilers and after 10 days the total mortalities amounted to 85.
House B was placed with 20 000 day-old broilers and when they were 10 days of age a total of 100 chickens had been counted as mortalities.
According to the procedure mentioned earlier, mortality can be calculated as follows:
For House A: 85/15000 X 100 = 0.56%
For House B: 100/20000 X 100 = 0.5%.

More chickens had died in House B but when expressed as percentage of the number placed, it was lower than for A. If such a trend persists then one would start looking for some management problems in House A.

Averages
Sometimes the word mean instead of average is used to describe the same concept. An average value is calculated by adding up all values in a range of figures and then to divide the sum by the number of figures in the range.

For example the following weights, in grams, were recorded for five individual day-old chickens: 42, 35, 40, 37 and 41. The sum of these five values is: 45+35+40+37+41 = 198. The average weight, or the mean = 198/5 = 39.6 g. (This sample is purely for demonstration purposes, one would never use such a small sample).

Sampling and accuracy of data

Sample size
The more birds one weighs the more reliable would the value be that one calculates as the average value. One or two outliers, extremely light or heavy, will have less influence on the total mass in a large sample than in a small sample. This is reason why sample sizes to estimate the average for a house would seldom be less than 800 birds weighed in houses of 30 000 birds.

The term that is often used is that a representative sample should be taken. This means that birds are fenced-in from particular areas, for example front, centre and the back of the house, and all birds within the frames are weighed. This ensures that the more flighty ones are also included in the sample and their weights were taken up into the calculation.

Accuracy of data

An aspect of immense importance is that the values that are being collected are reliable, whether it applies to bird weights or temperature recordings is immaterial. Conclusions drawn from data will only be valid is the collected data is accurate. For example: Instead of accepting a scale is accurate, why not always use a standard test weight to check the accuracy of the scale each time that birds are weighed.

When taking readings from thermometers make sure they have been tested against a reference thermometer that is reliable and always correct.

There is absolutely no sense in collecting unreliable figures. The reason for data collection is to enable one to identify factors that could have resulted in poor performance of the flock. The most common application is to relate high or low environmental temperatures to fluctuations in feed conversion or egg productions figures for a particular flock.

Use of graphs or charts

A graph is a picture of data collected. One wants to know what the trend is for example with mortality or egg production figures. When just looking at the figures as collected it is difficult to see whether there is a slow or rapid rate in the numbers of birds dying or production dropping. When data is plotted on a graph such trends are easy to identify.

When body mass and temperatures are graphed over time one can see how environmental factors had influenced growth or production rate. It means that one can explain a condition and not speculate whether it might have been a problem with feed.

In the poultry industry the keeping of records, and it is assumed that it was done accurately, is one of the most important tools to be efficient and profitable. Problems have to be identified as soon as possible to enable the taking of corrective actions, be it a problem with feed, disease, water or ventilation. Accurate records enables one to relate drops in growth rate with management changes for example in feeding practices, vaccination failures, or poor disinfection results due to changes in cleaning procedures etc. The reader will most probably be able to add more examples to this list.

Solution to Memory challenge number 1 Test your memory

challenge number 1 Nutrients and digestion

Across	Down		
	1	Digestion	The process by which feed is broken up to make the nutrients available
	3	Manganese	The mineral that is needed by the hen to prevent bone deformation, a condition known as perosis.
	4	Proteins	Substances in body tissues that consist of chains of amino acids
	6	Glucose.	The nutrient that can be utilized by the hen as source of energy.
	7	Skeleton	A framework of bones that needs calcium for its maintenance
	9	Calcium	This nutrient is a mineral and utilized in the formation of strong bones
	10	Vitamins	These nutrients are essential agents to facilitate chemical reactions inside body cells
	11	Soya	The oil cake meal from these beans is an important source of proteins for layers
2		Limestone	This product is added as a source of calcium in hen diets.
5		cells	The building blocks of organs in the body
8		Starch	This substance is made by plants and renders glucose after digestion
12		Nutrients.	The general term that is used for the substances after digestion of feed in the small intestine.
13		Energy.	The driving force for chemical reactions and obtained from the combustion of glucose.
14		Amino	These acids are the end products of protein digestion
15		Nutritionist	A person at the feed mill that does the formulation of poultry diets
16		Crumbs	Another word to describe the size of limestone grit.

Solution to memory challenge number 2

Across	Down		
	1	Respiratory	The inner lining of the tract of this system is affected by ammonia gas
	2	Cilia	Hair-like structures in the lining of the respiratory tract that remove dust and bacteria
	3	Ventilation	The word for movement of air through an opening
	5	Humidity	The word that describes the moisture content of air
4		Evaporation	The process by which water changes from a liquid to a gas
6		Ammonia	Skin burn under the feet of layers is caused by this gas
7		Dust	This material in the air of the hen house contains bacteria that causes infections on the inner lining of the respiratory tract
8		Crop	The hen is able to store feed in this organ for digestion at night

9		Dehydration	A condition where body cells have lost a lot of moisture due to water shortage in drinker lines