SOUTH AFRICAN POULTRY ASSOCIATION
SUID AFRIKAANSE PLUIMVEEVERENIGING

# Learning Module 3

# Poultry production and disease control (Bio Security, vaccination and house cleaning)

## Contents

Broiler production Bio Security

# Broiler Production: Biosecurity

The term bio-security would normally be used for actions to prevent contact between the broilers and the disease causing organisms (commonly known as germs). Such actions include access control of people onto a farm and the control of wild birds, insects, rodents etc. These are, however, not the only actions to protect the health of the birds. Other important measures include the prevention of the large scale multiplication of germs and implementing actions to allow chickens to grow in a stress-free environment.

**The purpose of this material is:**

1. To allow you to gain an understanding of the nature and spreading of germs that threatens the well-being of the birds. (In further discussion the words disease causing organisms will be used.)
2. Be aware of factors that favour the multiplication of disease causing organisms.
3. Be aware of factors that put stress in broilers that favour the disease causing organisms to overwhelm the health of the birds.

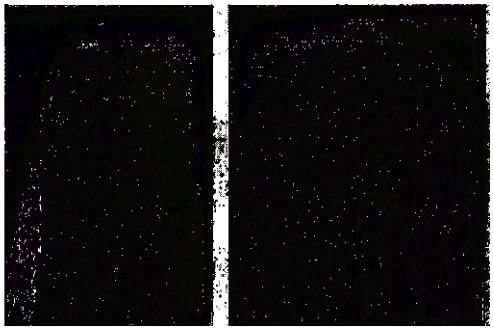
# Bio-security and the various disease causing organisms

## The types of disease causing organisms

There are four different types of disease causing organisms that can kill or make chickens sick. The fact they all need food and water for multiplication and a protective environment for their survival should thus be the first line of approach to kill or stop their multiplication:

| Lines of approach | Actions to take |
|---|---|
| Not to feed them | Remove sick and dead birds and damp material. Prevent feed spillage. Disease causing organisms multiply in dead and sick birds and also, in damp material such as spilled feed. |
| Not to give them water | Prevent water leakages from nipples and rain water into feed bins |
| Not to give them protection | Remove protective material such waste around poultry houses, dust on louvers and fan blades, open mortality drums because flies can carry germs. |

In the illustration below the tip of a needle with bacteria on the tip is shown. Viruses are generally ten times smaller than bacteria, thus very small and can only be seen under enlargement of a very strong microscope.



*Bacteria on the tip of a needle*

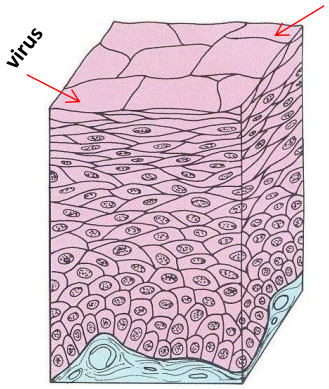
**Note to the learner:** The following aspects will now be addressed

- The ability of viruses, bacteria, protozoa and fungi to survive in the environment.
- What they need to reproduce themselves.
- How sick birds can infect healthy birds.

## Table 1 Characteristics of viruses, bacteria, protozoa and fungi

| **There are basically four types of disease causing organisms:** | |
|---|---|
| **Viruses** | Extremely small, can pass through the cell membrane into the cell. Can survive outside the body if protected against the sun. Reproduce themselves inside live cells.<br>Contaminate healthy birds: viruses can be present in exhaled air and saliva (moisture secreted in the mouth).<br>Cell reactions become disrupted, formation of new cells stops. |
| **Bacteria** | Protected by a membrane, survive in any kind of material. Reproduce by forming spores in dead chickens. Feed on wet bedding and uric acid, produce ammonia. Attack cell membranes and cause infections *E. coli* infections, yellow puss in air sacs and abdomen. |
| **Protozoa** | Very hardy organisms, survive in soil for months. Reproduce in lining intestine, cause bleeding of tissues.<br>Reproductive cells, called "oocysts" are excreted in faeces. Can't reproduce in dead birds. Spread by people that carry them into a building with their boots. (Footbaths important for control of protozoa.) |
| **Fungi (Mould)** | Primitive plants, grow on damp material. Reproduce by forming spores (seeds) can survive under severe and harsh conditions Deposits poisonous substances, mycotoxins, during growth. Mycotoxins suppress growth and immune development. |

**Piece of tissue showing the layers of cells with viruses penetrating outer membranes into cells**




**Attached to bone or other tissue**

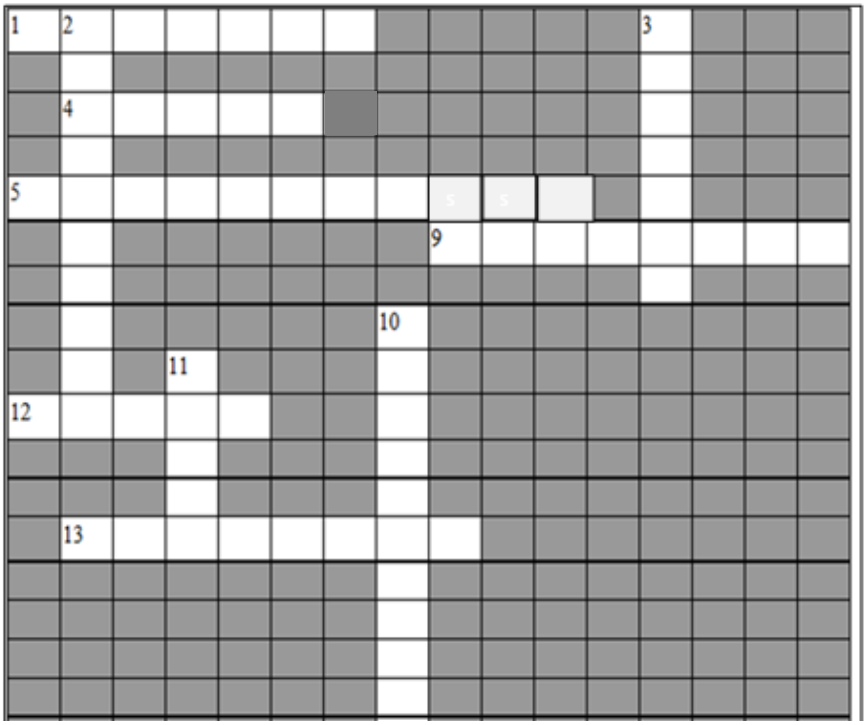
**Figure 2 Cross section through body tissue. Cells are the smallest working units of the body and are responsible to perform the functions of a particular organ.**

**Many different strains of bacteria exist in nature:**

1. Many fulfil useful functions and feed on waste material and dead birds.
2. Some bacteria produce medicine for the control of diseases such as cocci, an infection caused by protozoa.

Some species of bacteria produce amino acids that are used to supplement nutrient deficiencies in feedstuffs. How do you kill disease causing organisms? To put the right amount of a disinfectant onto them for the right period of time! **Always follow the instructions on the container. When in doubt ask your supervisor to assist you.**

# Test your knowledge memory challenge number 1



| Clue Across | Clue Down | |
|---|---|---|
| | 2 | This instrument is used to look at the structure of disease causing organisms under enlargement |
| | 3 | These organisms disrupt cell functions and need live cells for their multiplication. |
| | 10 | Poisonous substances secreted by mould |
| | 11 | These acids can be produced by bacteria to supplement certain nutrient deficiencies in feedstuffs. |
| 1 | | The gas that is formed by micro-organisms in wet bedding |
| 12 | | This word is collectively used for the disease causing organisms |
| 13 | | These organisms invade the linings of the intestinal tract to cause coccidiosis |
| 4 | | The smallest working units that make up all the different types of tissue in the body |
| 5 | | The name of the disease where the wall of the intestinal lining is invaded by the organisms that cause the disease |
| 9 | | These organisms fulfil useful functions but they also cause infections in tissue of the air sacs |

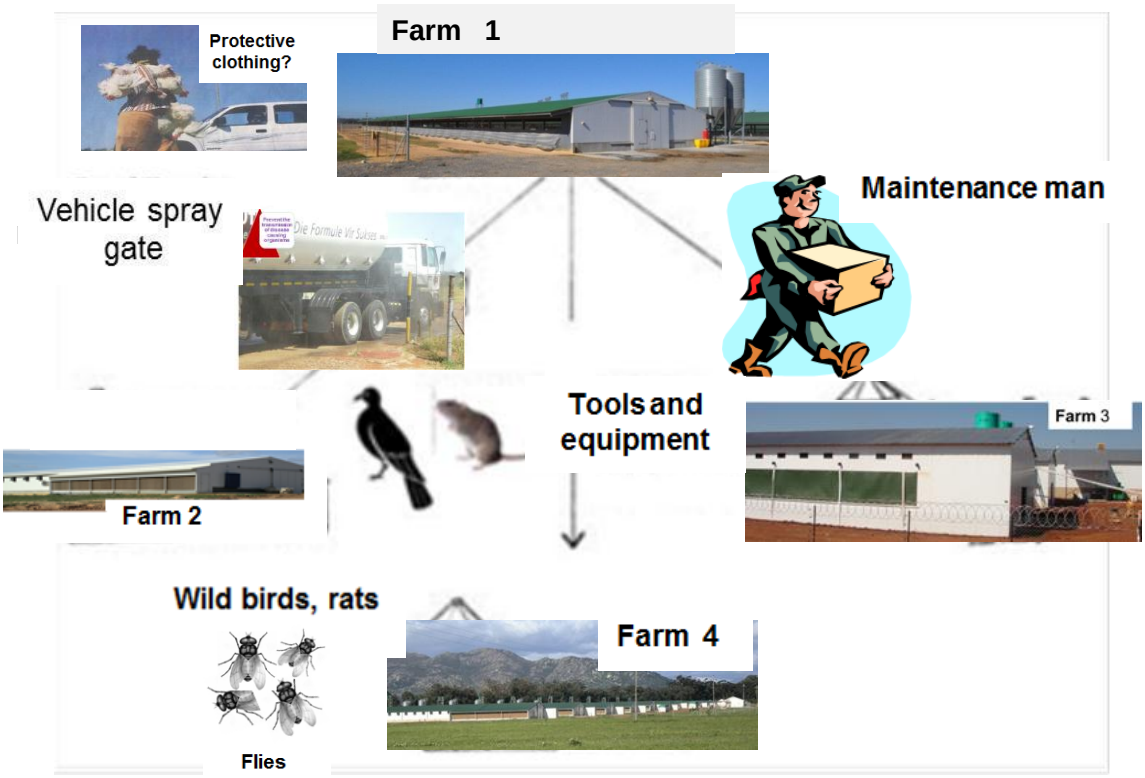
**Note to the learner.**
Memory challenge number 1 is based on information you have learned so far on the types of disease causing organisms commonly found in Broiler production. See how far you can get without referring to the notes. If you find that you not able to complete the challenge a suggestion is to read through the notes again slowly and carefully. Should you find you are unable to understand some of the concepts then you need to discuss these with your supervisor or facilitator.

**Important knowledge: Means by which disease causing organisms can come in contact with the chickens.**
A disease will develop if organisms such as viruses, bacteria, protozoa or mycotoxins infects (penetrates) the body of the bird.

**The essence of bio-security is to prevent contact.**
A healthy chicken will remain healthy as long as there is no direct contact between the chicken and viruses, bacteria, protozoa or mycotoxins.

| Means of spreading | Control measures to prevent spreading |
|---|---|
| **Carried by man.**<br>(Staff and maintenance crew): People visit the shops in town and make contact with persons that had handled poultry. | Staff must wear protective clothing after showering in. |
| **Carried by rodents.**<br>Rats and mice excrete bacteria, Salmonellae, in their droppings. This organism causes diarrhoea in humans. | Bait stations to control rats and mice must be inspected regularly. |
| **Carried by birds**.<br>Viruses that cause IB and Newcastle disease are carried by wild birds and can infect the chickens. | Control wild birds by preventing feed spillage outside buildings. Keep wild birds out of buildings. |
| **Carried by insects**<br>(flies and litter beetles). Carry viruses and bacteria on body hair. | Control flies at their breeding sites and spraying walls with insecticide and to cover mortality containers. Litter beetles controlled by means of band-spraying insecticide at depopulation of a building. |
| **Carried by wind, dust and feathers.**<br>Wind carries dust and feathers from sick birds on trucks that pass the farm. | During housecleaning restrict as far as possible the spreading of dust and feathers to surrounding areas and thus lowering the population of disease causing organisms as much as possible. |
| **Carried by equipment.**<br>Equipment that is brought onto the site by the maintenance teams can carry disease causing organisms. | Equipment such as toolboxes used by maintenance personnel should be disinfected at the point of entry to a farm, especially their bottoms, of the toolboxes! |
| **Carried by water.**<br>Slime (fungi) grows inside water lines and produce poisonous substances that make chickens more at risk to get sick. | Water lines have to be flushed with the right cleaning agent to remove the fungi (slime) that produces growth depressants. |
| **What else can be done to control contact between disease causing organisms and the chickens?** | Always have an open eye for possible means by which disease causing organisms can enter a farm or a poultry house. |

**Success of biosecurity practices starts with you!!**

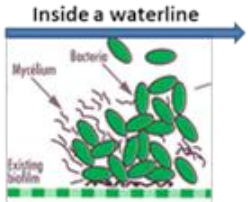



***Possible entry and contact routes for disease causing organisms to the poultry***

In the illustration above some of the contact and transmission routes of disease causing organisms is illustrated. See what has been omitted and make a short summary for yourself. Not mentioned in the illustration, and which is of great importance, is the water supply to the chickens[1]. Bacteria grow inside the water line forming a jelly-like mass known as biofilm see the illustration below.

Water, if contaminated, can thus indeed be regarded as a carrier of disease causing organisms.

***Biofilm in water lines***

| | |
|---|---|
|  Bacterial growth with bacteria coming free to form new cluster. | **Portions of this biofilm with bacteria come free from time to time. They form more clusters that block the water nipples. Biofilm can form within a period of 2 – 4 days after a cleaning operation.** |
| | **After depopulation all pipe work should be thoroughly cleaned with a dedicated water line cleaner and flushed.** |

[1] Permission for reprinting was kindly granted by the author of the booklet: Rational Antibiotherapy In Poultry Farming, page 17, by L. Mogenet, Ceva Santé Animale.

## The role of stress in biosecurity.

Stress is the result of harmful or uncomfortable situations and the brain is stimulated to prepare the body for action:

- The heart increases its rate to pump blood.
- Breathing rate increases and muscles become tight in preparation to fight or flee.
- These actions use energy and result in lowering of glucose levels in the blood:
- Birds become more at risk to get sick because of the lack of glucose to supply energy for the formation of antibodies to fight disease causing organisms in the environment.
- Once a disease outbreak occurs, more and more birds get sick. Viruses multiply in sick birds and their numbers simply overwhelm the birds. It thus means a total collapse of biosecurity.

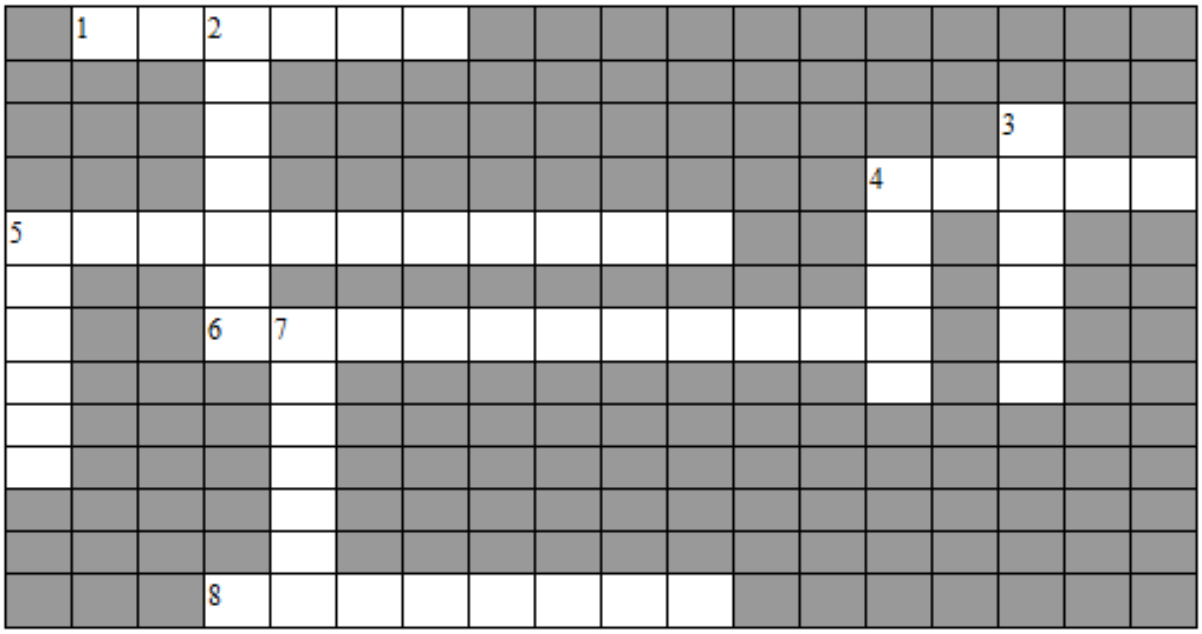
**Factors that can be causes of stress: Feed, Light, Air, Water, Sanitation and Space (acronym FLAWSS).**

| Stress factors | Possible shortcomings | Effect of the particular shortcoming: A breach in biosecurity might develop |
|---|---|---|
| **Feed** | Feeders out of reach | Low feed intake results in low energy reserves in the body and the birds are thus unable to fight the disease causing organisms. |
| | Feed structure, wrong pellet size | Birds refuse to eat dusty feed or pellets are too large and cannot be eaten. |
| | Mouldy feed | Contains poisonous substances, mycotoxins that lower resistance to disease. (Immunity is suppressed.) |
| **Light** | Light and dark areas (some light bulbs out) | Overcrowding of birds in the more brightly lit areas, smaller ones deprived of feed, become runts and highly under stress, more vulnerable to diseases. |
| **Air** | Ventilation not right, too much or too little. | High ammonia and dust. Tissue in respiratory tract damaged and easy penetration of inhaled bacteria into tissue of the air sacs. |
| | Over-ventilated especially at night. | House temperatures low, poor moisture removal from bedding material. Ammonia levels high due to wet bedding. Respiratory diseases develop. |
| | Air speed low at night | Cold spots near intakes. Chickens congregate in the centre of the house. Bedding wet. |
| **Water** | Waterlines out of reach | Dehydration of the inner lining of the respiratory tract and easy penetration of disease causing organisms into the cracks. |
| | Bacteria in waterline due to improper cleaning. | Bacteria produce poisonous substances that cause birds to be more susceptible to diseases. |
| **Sanitation (or cleanliness)** | Mortalities in unsealed bins | Flies increase in numbers and carry viruses and bacteria to healthy birds. |
| | Bait stations, footbaths in poor condition | Rats and mice carry Salmonella bacteria. People's feet carry coccidiosis organisms into chicken houses. |
| | Wild birds present in large numbers | Feed spillage attracts wild birds, they are carriers of viruses and bacteria. |
| **Space** | Cold spots and draughts<br>Not all feeder and water lines full or accessible | Overcrowding in comfortable areas, feed and water not available to all, runts develop.<br>Wet bedding and ammonia develops. |

# Test your knowledge memory challenge number 2

**Memory challenge**

| | |
|---|---|
| Write down seven means or processes by which disease causing organisms can be transmitted to birds in a house. Important to say how transmission or infection can take place and what you will do to prevent transmission. | 1. |
| | 2. |
| | 3. |
| | 4. |
| | 5. |
| | 6. |
| | 7. |
| Why can poor feed intake be seen as a stress factor? | |
| Why can water become a stress factor? | |
| How can air become a stress factor? | |
| How can poor sanitation become a stress factor? | |



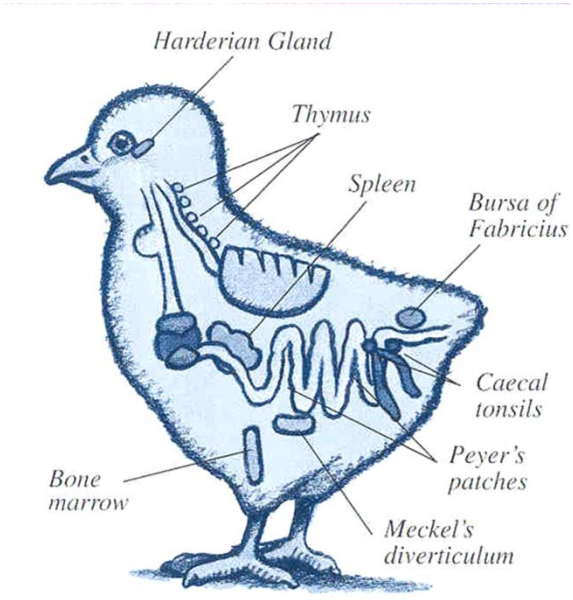
| Clue Across | Clue Down | | |
|---|---|---|---|
| | 2 | | A single word for describing rats and mice |
| | 3 | | Required for an action to take place |
| | 4 | | Insects that can distribute viruses by means of their body hair |
| | 5 | | Feed in this condition contains poisonous substances that lowers resistance to disease |
| | 7 | | This gas causes damage to tissues of the respiratory tract in chickens |
| 1 | | | The condition in reaction to harmful and uncomfortable situations |
| 4 | | | It grows inside water lines blocking water nipples and can depress growth of broilers |
| 5 | | | The crew responsible to fix broken equipment might be carriers of disease causing organisms |
| 6 | | | The bacterium carried by rats and mice and causes diarrhoea in humans |
| 8 | | | These micro-organisms form films inside water lines and cause blockage of water nipples |

**Note to the learner.**

Memory challenge number 2 is based on information you have learned so far on the spread of disease causing organisms in Broiler production. See how far you can get without referring to the notes. If you find that you not able to complete the challenge a suggestion is to read through the notes again slowly and carefully. Should you find you are unable to understand some of the concepts then you need to discuss these with your supervisor or facilitator.

## Role of vaccines in bio-security

**Terminology explained:**

<table>
<tr><td>Disease</td><td>An abnormal condition of the body. Cells of an organ have been attacked by disease causing organisms. Show symptoms such as inflammation and unable to perform their normal functions.</td><td rowspan="2">  <br>  <br>The cells of inner tissue of intestine damaged by organisms. Symptoms, blood in droppings, are clearly visible</td></tr>
<tr><td>Symptoms</td><td>The visible signs of a disease in an organ. Sometimes very specific in an organ for a particular disease but mostly not the case. Picture on right.</td></tr>
<tr><td>Vaccine</td><td>It is not medicine!! It contains the disease causing organism in a weakened state.<br>In an overdose it can kill the birds.<br>Correct dosage stimulates the formation of antibodies<br>Organs involved in antibody production to protect the bird against a particular disease are shown in the drawing of a chicken at the bottom of the adjacent column.</td><td>  <br>Dry powder at the bottom of the vial is the dry vaccine, can be viruses<br>  <br>Day-old chickens being sprayed with vaccine. Taken up into the body is via the membranes of the eye lid and nose.</td></tr>
<tr><td>Vaccination</td><td>The process by which a vaccine is given to the birds: in the drinking water, sprayed or by injection.<br>It must penetrate the body.</td><td rowspan="3">  </td></tr>
<tr><td>Antibodies</td><td>Chemical substances that were produced by certain organs in the body in response to the application of a vaccine.</td></tr>
<tr><td>Immunity</td><td>To have defences:<br>Antibodies in the blood as protection against a specific disease.<br>A well protected bird will have high numbers of antibodies in blood stream. Organs involved in antibody production include the Bursa of Fabricius, the thymus glands along the neck, the bone marrow, spleen and other, see picture.</td></tr>
<tr><td>Gland</td><td colspan="2">Is an organ that can secrete substances such as mucus or absorb substances such as vaccine.</td></tr>
</table>

## Factors that determine the success of the vaccination process (development of immunity).

It is well known that human errors are the main causes of failures when vaccinated birds do not develop sufficient immunity. This means that either only a small portion of the flock developed antibodies or the antibody levels in the blood was low.

**Table 3**

**Important considerations to take into account when vaccinating.**

| | |
|---|---|
| 1. The vaccine has to be kept in a cool-box at 4 – 8 °C during transport until mixing into water takes place. | A vaccine consists of the live form of the disease causing organisms. Temperature fluctuations destroy them. |
| 2. The number of vaccine doses mixed into drinking water, or sprayed onto the chickens, must correspond to the number of birds that have to be vaccinated. | The number of doses of vaccine a bird consumes determines the number of antibodies (the level of immunity) that will develop. |
| 3. Important to check the expiry date on the vials containing the vaccine. | Live vaccines have a limited lifetime and will lose their potency with time. |
| 4. The drinking water containing the vaccine, or the water used for spraying, must be free from chlorine. (Procedures to ensure low chlorine levels in drinking water have to be strictly followed.) | Chlorine is a disinfectant and will kill those organisms (viruses or bacteria) that were used in the manufacturing of the vaccine. |
| 5. Each bird must receive its full share of the vaccine solution to ensure uniformity of immune levels. House temperatures should be taken into consideration to ensure sufficient water volumes for drinking or spraying. | Birds that have not consumed the right amount of vaccine will not be immune against the disease they were vaccinated for. |
| 6. Birds suffering from some form of stress must not be vaccinated. | Stress causes a shortage of energy. Not enough energy will be available to form antibodies in response to the vaccine. The result is a low level of antibodies and the birds are poorly protected. |

# Fill in the missing words challenge

**Note to the learner.**
See how many of the missing words you can fill in. See how far you can get without referring to the notes. If you find that you not able to complete the challenge a suggestion is to read through the notes again slowly and carefully. Should you find you are unable to understand some of the concepts then you need to discuss these with your supervisor or facilitator.

1. Symptoms: The visible_____ of a particular disease.

2. Vaccine: It is the_____ in a weakened state.

3. Dry powder at the bottom of the vial is the dry_____ can be viruses.

4. The_____by which a vaccine is given to the birds: in the drinking water, sprayed or by injection.

5. To have sufficient defences, meaning_____, to avoid a disease to develop in the body of the chicken.

6. Antibodies are_____ that are able to recognize the organism that was used for making the vaccine and will_____ to that organism when it penetrates the bird.

7. The vaccine has to be kept in a cool box at _____during transport.

8. A vaccine consists of the_____of the disease causing organisms and temperature_____ fluctuations will destroy them.

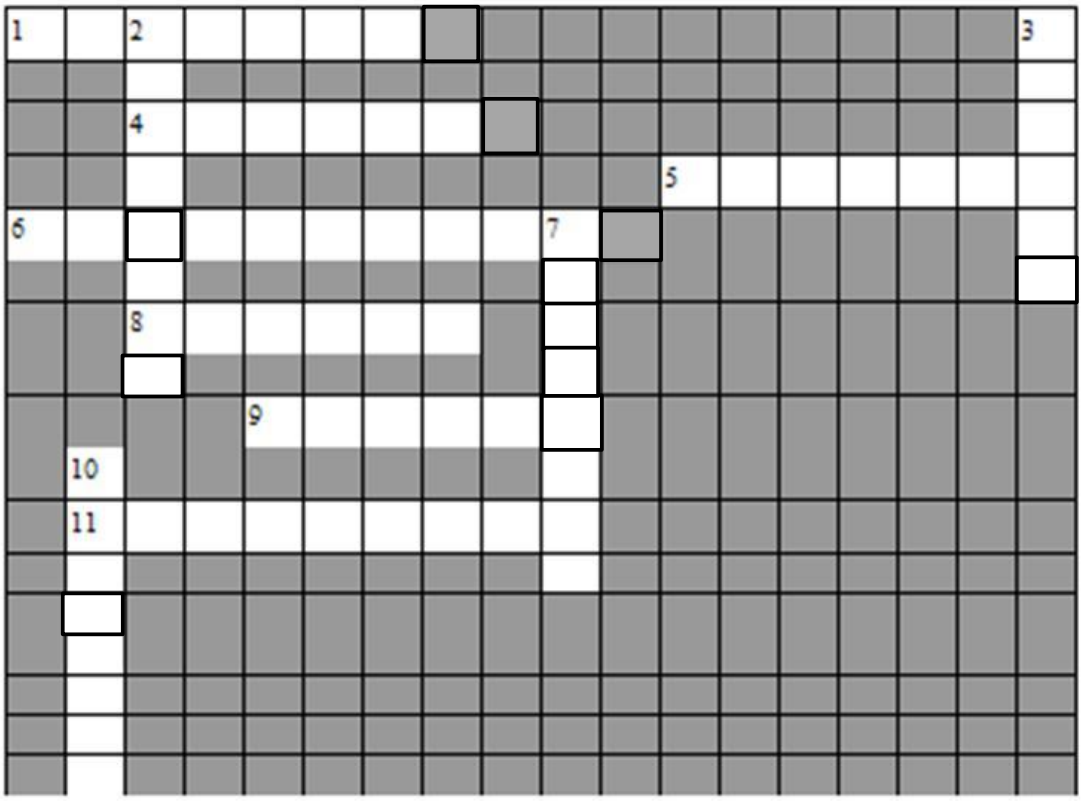
9. Chlorine is a _____and will destroy the viruses or bacteria.

10. Birds that have not consumed the_____ amount of vaccine will have low levels of antibodies.

11. Stress causes a_____ of energy.

12. Birds_____from some form of _____ must not be vaccinated.

# Test your memory challenge number 3



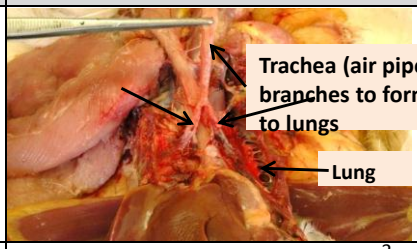
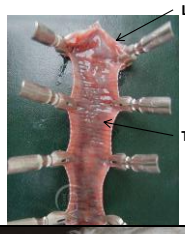
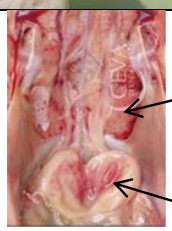

| Clue Across | Clue Down | | |
|---|---|---|---|
| 1 | | | During such a condition typical symptoms might be visible |
| | 2 | | The visible signs of a disease |
| 5 | | | A substance used to stimulate immunity against a disease in birds |
| 6 | | | The chemicals produced in responses to successful vaccination |
| 4 | | | Tissue inside bone cavity that is involved in antibody production |
| 8 | | | The name of a diverticulum that is involved in antibody production |
| | 7 | | One of the methods by which a vaccine can be applied |
| 11 | | | The name of a gland that is can absorb a sprayed vaccine |
| 9 | | | This date is important to check on the vaccine vials |
| | 10 | | Drinking water used for mixing with a vaccine must be free of this disinfectant |
| | 3 | | Birds suffering from some form of this condition should not be vaccinated |

**Note to the learner.**
Memory challenge number 3 is based on information you have learned so far on the role of vaccination in Broiler production. See how far you can get without referring to the notes. If you find that you not able to complete the challenge a suggestion is to read through the notes again slowly and carefully. Should you find you are unable to understand some of the concepts then you need to discuss these with your supervisor or facilitator.

## Diseases of importance to the broiler farmer

Some diseases might have very typical symptoms (visible signs) by which they can be recognized. However, many diseases show symptoms that are the same for different disease causing organisms (viruses or bacteria). In many cases of a disease outbreak the veterinarian will take tissue samples and have them analysed in the laboratory to identify without doubt the organisms responsible for causing the disease. In the following table a summary is given of the main diseases of relevance to broilers.

**Six commonly occurring diseases that threaten the well-being of broilers.**

| Name | Organ affected | |
|---|---|---|
| 1. Infectious bronchitis[2] (IB) | The name tells you that the bronchi, the tubes to the lungs, are infected. |   |
| 2. ILT (Infectious laryngo tracheitis) | Both parts of the respiratory tract, the larynx as well as the lower portion, the trachea, are infected. |   Permission[3] |
| 3. Newcastle disease (Newcastle disease | Nervous system is infected, no control of neck muscles. Blood spots visible on surface of the proventriculus. |   |
| 4. TRT, (Turkey rhino-tracheitis). Swollen head syndrome or Dikkop | Tissue inside sinuses (cavities) of the nose, the head and upper respiratory tract gets infected. |  |
| 5. Infectious bursal disease, (IBD), Gumboro | Tissue of the bursa of Fabricius infected, tissue shows signs of bleeding. |  Kidneys<br>Bursa showing red spots |

[2] Very common to hear chickens snicking after they had been vaccinated for IB, it means they absorbed the vaccine.

[3] Permission to use the CEVA pictures was kindly granted by Prof. Ivan Dinev, Faculty of Veterinary Medicine, Trakia University, 6000 Stara Zagora, Bulgaria. E-mail:idinev@uni-sz.bg.

| | | | |
|---|---|---|---|
| 6. Coccidiosis | Intestines show spots of infection on the outside of intestine. Bleeding on the inside of intestine. |  |  |

## Role of sanitary conditions

The word sanitizing has the same meaning as cleaning or decontaminating or washing and can even mean disinfecting. All these words are applicable to the processes of cleaning a broiler house after depopulation. The main aim is to decrease the number of disease causing organisms and to destroy (kill) those that might have remained behind after the cleaning process.

**For the sake of revision answer the following questions regarding the disease causing organisms:**

## Complete the table

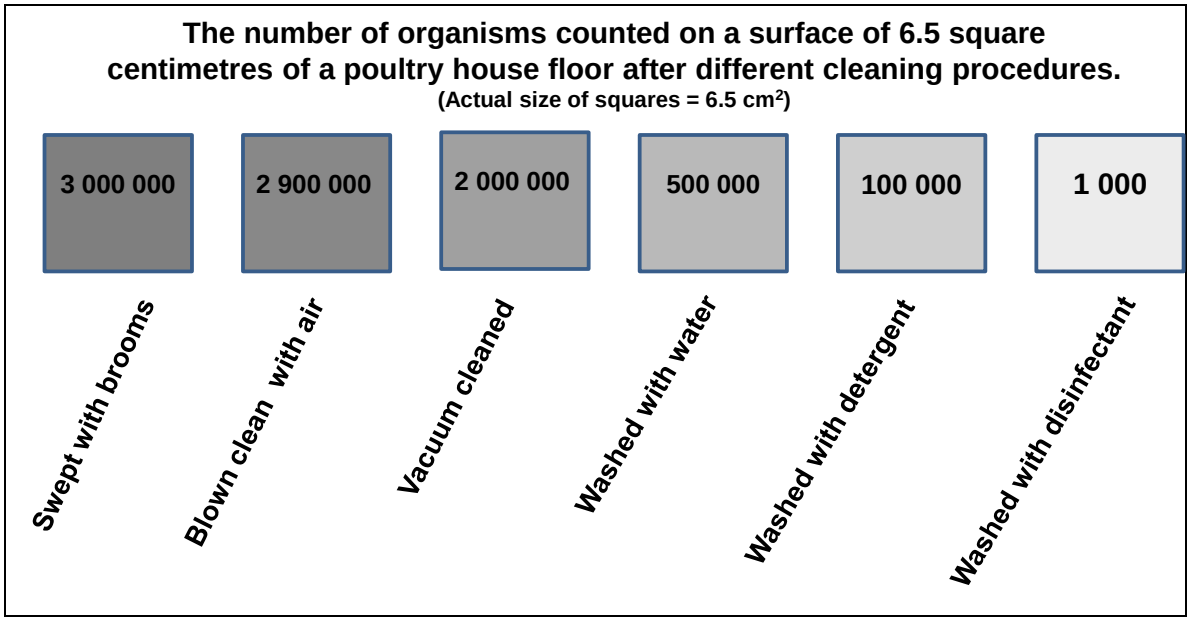
Characteristics of the disease causing organisms

| **Give a short description to the questions in the first column** | | |
|---|---|---|
| **Viruses** | How do they multiply? | |
| | Can they penetrate cells of the body and what is the effect? | |
| | Can they feed on dead birds and increase in numbers? | |
| | How can they survive outside the body? | |
| | Name three ways in which they can be spread to infect healthy birds | |
| **Bacteria** | How do they multiply? | |
| | Can they penetrate cells of the body and what is the effect? | |
| | Can they feed on dead birds and increase in numbers? | |
| | How can they survive outside the body? | |
| | Name three carriers by which bacteria can be spread to infect healthy birds. | |

**Characteristics of the disease causing organisms (continued**)

| **Give a short description to the questions in the first column** | | |
|---|---|---|
| **Protozoa** | How do they multiply? | |
| | Can they penetrate cells of the body and what is the effect? | |
| | Can they feed on dead birds and increase in numbers? | |
| | Can they survive outside the body? | |
| | Name the most important way in which they can be spread to infect healthy birds | |
| **Fungi (mould)** | What are fungi? | |
| | How does it multiply? | |
| | What does it need to multiply? | |
| | What negatives effects does mould growth has on chickens? | |

## Cleaning poultry houses after depopulation.




***The effect of washing and using detergents on the removal of disease causing organisms in poultry houses***[4]

The effect of different cleaning procedures on the number of organisms on a surface area of 6.5 square cm is illustrated in **Error! Reference source not found.**. It will be noted that after each step the number of organisms decreased. A dramatic change occurred after washing with water: the numbers decreased from 2 million to 500 000 per 6.5 sq cm, a four times (4X) decrease in numbers. Using a detergent had a still larger effect, from 500 000 to 100 000, thus a decreases of five times. The disinfectant had the largest effect to decrease microbe numbers, namely a hundred (100) times, from 100 000 to 1 000 organisms per 6.5 $cm^2$. This stresses the need to use and apply disinfectants correctly.

the table below a summary of actions and the reasons for actions during cleaning operations is explained. The steps probably differ between companies but it is important to take note of the reasons why actions are performed and to pay special attention to those actions that have the largest effect on the elimination of microbial counts in a broiler house, namely the application of a disinfectant on a clean surface, take another good look at the illustration above on the effect of washing and using detergents on the removal of disease causing organisms in poultry houses.

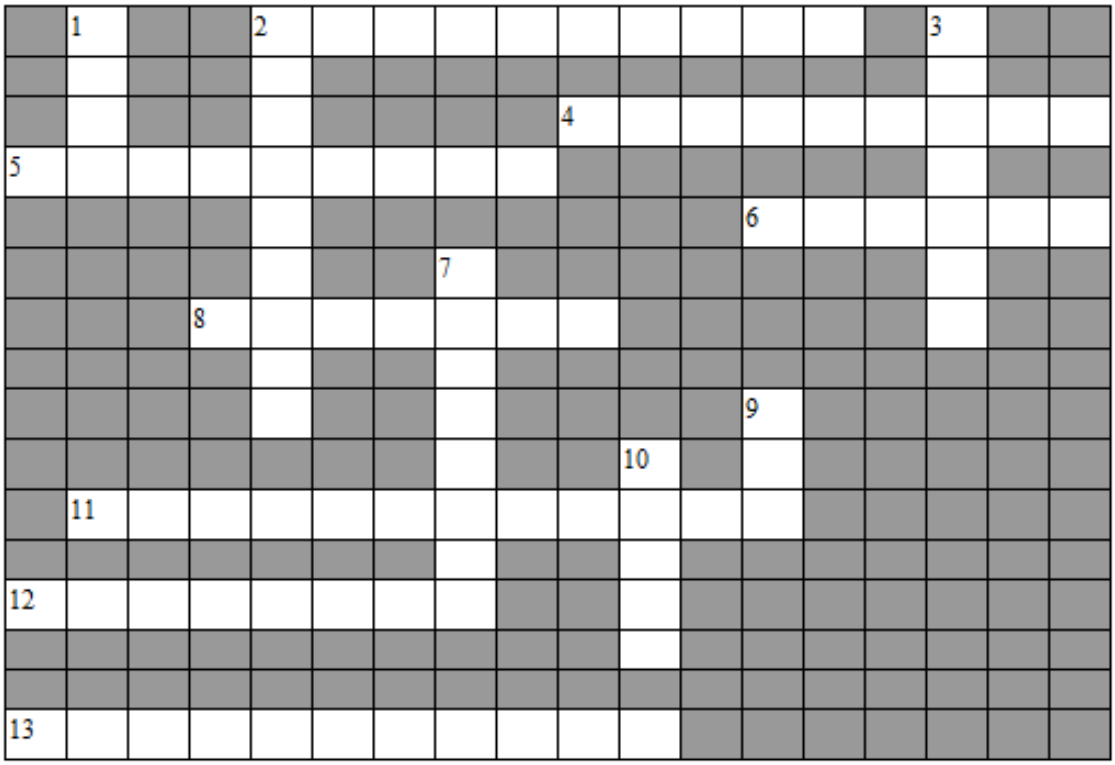
[4] Quoted by L. Ledoux, The importance of hygiene and terminal disinfection, page 1 – 6 Chick Quality 2004, hosted by International Hatchery Practice and Poultry Production.Hannover, Germany.

# Cleaning of poultry houses:
# Steps taken after houses have been depopulated

| Steps | Actions | Reasons |
|---|---|---|
| 1. Apply health and safety regulations | Wear protective clothing (PPE) and masks | Inhalation of dust irritates eyes and membranes of the respiratory tract.<br>Mould spores in air can grow in human lungs. |
| 2. Total depopulation of the poultry house | Eliminate all loose and stray poultry (yard birds) outside the house | Poultry are carriers of disease-causing organisms and allow viruses to multiply. |
| 3. Switch off electricity supply to the building and equipment | Mains are turned off | Water that is sprayed onto an electric circuit can cause the death of a worker. |
| 4. Removal of all remaining feed | Augers, hoppers and feed bins completely cleaned and all feed lumps containing mould removed. | Mould spores give rise to mould growth in new feed.<br>Mycotoxins are produced during mould growth and depress immune development. |
| 5. Removal of loose equipment. | All movable equipment to be taken apart and moved out for the cleaning operation. | Thorough cleaning is made easy on a wash bay.<br>Disease causing organisms killed when exposed to sunlight |
| 6. Removal of all bedding material | Spreading of feather and dust must be minimized.<br>Do not pile or spread litter near poultry houses, it attract rats and mice. | Bedding material contains very high numbers of microbes.<br>Microbes spread by means of dust.<br>Minimize microbes in the surroundings of a poultry farm. |
| 7. Dry cleaning of building. This would include the first three steps illustrated in **Error! Reference source not found.**. | Sweeping of large particles, then using air under pressure to remove dust from fans and louvers and to concentrate dust on a particular area before vacuum cleaning to remove dust. After vacuum cleaning there would still be 2 million microbes per 6.5 $cm^2$. (equal to 20 billion per sq. meter.) | Bedding material and dust contain large numbers of microbes including *E. coli* bacteria. The removal of visible material has a very large effect to decrease the bacterial load in a house. (Poultry litter contains 8 billion *E. coli* bacteria per gram (8 billion = 8 000 000 000 000). Poultry house dust contains between 200 000 to 800 000 coli bacteria per gram.) |
| 8. Washing with water. | This would entail the use of high pressure washers to remove stubborn organic matter adhering to the floor. | Loose material provides protection to microbes. Direct contact between disinfectant and organism is necessary to kill the organisms. |

| | | |
|---|---|---|
| 9. Washing with detergent (This is often combined with the previous step namely washing with water.) | A detergent is added to the washing water according to the instructions on the container. From **Error! Reference source not found.** it will be noted that a detergent lowered the microbe count from 500 000 to 100 000, thus a five-fold lowering. | Function of a detergent is to make fats soluble in water and be easily removable. Fats will protect organisms from coming in contact with a disinfectant and they will thus not be destroyed. |
| 10. Applying a disinfectant | The function of a disinfectant is to kill microbes, this action depends on: The concentration of the mixture is most important; too weak will have little effect. The temperature: Too low will have a poor effect. Period of contact: Too short will not be effective. Disinfectant solution must not become dry before the specified disinfection period is over. From **Error! Reference source not found.** it will be noted that the disinfectant lowered the microbe count from 100 000 to 1000, thus a 100 fold lowering. | To kill as many microbes as possible. Day-old chickens should not be exposed to high levels of disease causing organisms as their immune system is still poorly developed. |
| 11. Placing of equipment, performing maintenance and placing of bedding material. | All repairs and replacements complete before fumigation | Maintenance teams should not need to visit poultry houses after disinfection. The risk of bringing in disease causing organisms is too big. |
| 12. Final fumigation | Perform the correct procedures for mixing and applying fumigant with regard to temperature, 25 °C, humidity and length of time period. | This is the final attempt to ensure an environment with a bacterial load as low as possible for day-old chickens. |
| 13. Cleaning of entrance paths to doors. | Remove feathers and bedding material that offer protection to disease causing organisms. | The outside surroundings with a low bacterial count decrease the possibility of carrying disease causing organisms into the poultry house. |

# Test your memory challenge number 4



| Clue Across | Clue Down | |
|---|---|---|
| 5 | | Used in the cleaning process to remove fats and stubborn material from floors and equipment |
| | 2 | The evaluation of the success of cleaning is based on such counts |
| 6 | | Face masks should be worn to avoid the inhalation of these seeds from primitive plants |
| 2 | | Substances produced by mould that depress immune development in poultry |
| 8 | | This material can contain up to 8 billion *E. coli* bacteria |
| | 1 | The factor by which the number of organisms on an area can be decreased by using a detergent as cleaning agent |
| | 3 | The factor by which the number of organisms on an area can be decreased when a disinfectant is applied |
| | 7 | They keep chickens warm but also offer protection to disease causing organisms |
| 11 | | This is used to kill microbes |
| 12 | | This word refers to all types of disease causing organisms |
| | 10 | The protective equipment that covers your nose and mouth |
| 4 | | Tissue of the respiratory tract that is irritated by dust |
| | 9 | The substance that becomes soluble when treated with a detergent |
| 13 | | The teams that should not enter poultry houses after a final fumigation |

# Solutions to memory challenges 1-4

# Memory challenge number 1

| Across | Down | | |
|---|---|---|---|
| | 2 | Microscope | This instrument is used to look at the structure of disease causing organisms under enlargement |
| | 3 | Viruses | These organisms disrupt cell functions and need live cells for their multiplication. |
| | 10 | Mycotoxins | Poisonous substances secreted by mould |
| | 11 | Amino | These acids can be produced by bacteria to supplement certain nutrient deficiencies in feedstuffs. |
| 1 | | Ammonia | The gas that is formed by micro-organisms in wet bedding |
| 12 | | Germs | This word is collectively used for the disease causing organisms |
| 13 | | Protozoa | These organisms invade the linings of the intestinal tract to cause coccidiosis |
| 4 | | Cells | The smallest working units that make up all the different types of tissue in the body |
| 5 | | Coccidiosis | The name of the disease where the wall of the intestinal lining is invaded by the organisms that cause the disease |
| 9 | | Bacteria | These organisms fulfil useful functions but they also cause infections in tissue of the air sacs |

# Memory challenge number 2

| ACROSS | DOWN | | |
|---|---|---|---|
| | 2 | rodents | A single word for describing rats and mice |
| | 3 | Energy | Required for an action to take place |
| | 4 | Flies | Insects that can distribute viruses by means of their body hair |
| | 5 | Mouldy | Feed in this condition contains poisonous substances that lowers resistance to disease |
| | 7 | Ammonia | This gas causes damage to tissues of the respiratory tract in chickens |
| 1 | | Stress | The condition in reaction to harmful and uncomfortable situations |
| 4 | | Fungi | It grows inside water lines blocking water nipples and can depress growth of broilers |
| 5 | | maintenance | The crew responsible to fix broken equipment might be carriers of disease causing organisms |
| 6 | | salmonellae | The bacterium carried by rats and mice and causes diarrhoea in humans |
| 8 | | Bacteria | These micro-organisms form films inside water lines and cause blockage of water nipples |

# Memory challenge number 3

| Across | Down | | |
|---|---|---|---|
| 1 | | Disease | During such a condition typical symptoms might be visible |
| | 2 | Symptoms | The visible signs of a disease |
| 5 | | Vaccine | A substance used to stimulate immunity against a disease in birds |
| 6 | | Antibodies | The chemicals produced in responses to successful vaccination |
| 4 | | Marrow | Tissue inside bone cavity that is involved in antibody production |
| 8 | | Meckel | The name of a diverticulum that is involved in antibody production |
| | 7 | Spraying | One of the methods by which a vaccine can be applied |
| 11 | | Harderian | The name of a gland that is can absorb a sprayed vaccine |
| 9 | | Expiry | This date is important to check on the vaccine vials |
| | 10 | Chlorine | Drinking water used for mixing with a vaccine must be free of this disinfectant |
| | 3 | Stress | Birds suffering from some of this condition should not be vaccinated |

# Memory challenge number 4

| Across | Down | | |
|---|---|---|---|
| 5 | | detergent | Used in the cleaning process to remove fats and stubborn material from floors and equipment |
| | 2 | microbial | The evaluation of the success of cleaning is based on such counts |
| 6 | | Spores | Face masks should be worn to avoid the inhalation of these seeds from primitive plants |
| 2 | | mycotoxins | Substances produced by mould that depress immune development in poultry |
| 8 | | litter | This material can contain up to 8 billion *E. coli* bacteria |
| | 1 | Five | The factor by which the number of organisms on an area can be decreased by using a detergent as cleaning agent |
| | 3 | Hundred | The factor by which the number of organisms on an area can be decreased when a disinfectant is applied |
| | 7 | Feathers | They keep chickens warm but also offer protection to disease causing organisms |
| 11 | | disinfectant | This is used to kill microbes |
| 12 | | microbes | This word refers to all types of disease causing organisms |
| | 10 | Masks | The protective equipment that covers your nose and mouth |
| 4 | | membranes | Tissue of the respiratory tract that is irritated by dust |
| | 9 | Fat | The substance that becomes soluble when treated with a detergent |
| 13 | | maintenance | The teams that should not enter poultry houses after a final fumigation |

# Solution for completing the table

| | |
|---|---|
| Write down seven means or processes by which disease causing organisms can be transmitted to birds in a house. Important to say how transmission or infection can take place and what you will do to prevent transmission. | 1 Waterlines can contain bacteria that grow inside them. Prevention by proper cleaning with the right products at the right concentration. |
| | 2 Staff that enters the site after shopping in town or having contact with contaminated persons carry organisms on their clothes and shoes. Prevention is by showering and wearing protective clothing. |
| | 3. Rodents carry Salmonellae bacteria and these are excreted in their droppings. Prevention is by means of maintenance of bait stations. |
| | 4. Wild birds carry viruses of Newcastle disease and IB. Feed spillage that attracts birds must be prevented. |
| | 5. Flies and litter beetles carry disease causing organisms. Regular application of insecticides at breeding places. |
| | 6. Contaminated feathers and dust is carried by the wind into poultry houses. Areas around poultry houses must be kept clean and spilling of bedding material during clean-out prevented. |
| | 7. Equipment used by maintenance teams gets contaminated. Proper disinfection must be applied before entering a site. |
| Why can poor feed intake be seen as a stress factor? | With low energy reserves birds are unable to fight against the disease causing organisms. |
| Why can water become a stress factor? | Water lines that have not been cleaned properly can contain poisonous substances formed by bacteria inside the line. |
| How can air become a stress factor? | Air with high levels of ammonia will cause cracks in the lining of the respiratory tract and thus easy penetration of disease causing organisms into the body. |
| How can poor sanitation become a stress factor? | Dead birds lying around, spilt feed and wet conditions creates conditions for bacterial growth that will overwhelm the bird's ability to stay healthy. |

# Solution for the missing word challenge

| |
|---|
| 1. Symptoms: The visible **signs** of a particular disease. |
| 2. Vaccine: It is the **disease causing organism** in a weakened state |
| 3. Dry powder at the bottom of the vial is the dry vaccine, can be viruses. |
| 4. The process by which a vaccine is given to the birds: in the drinking water, sprayed or by injection. |
| 5. To have sufficient defences, meaning **antibodies**, to avoid a disease to develop in the body of the chicken. |
| 6. Antibodies are chemicals that are able to recognize the organism that was used for making the vaccine and will bind to that organism when it penetrates the bird. |
| 7. The vaccine has to be kept in a coolbox at 4 – 8 °C during transport |
| 8. A vaccine consists of the live form of the disease causing organisms and temperature fluctuations destroy them. |
| 9. Chlorine is a disinfectant and will destroy the viruses or bacteria… |
| 10. Birds that have not consumed the right amount of vaccine will have low levels of antibodies. |
| 11. Stress causes a shortage of energy. |
| 12. Birds suffering from some form of stress must not be vaccinated. |
| |
| |

# Solution to characteristics of disease causing organisms

| | | **Your comments and answers in this column** |
|---|---|---|
| **Viruses** | How do they multiply? | They can only multiply inside the cells of a particular tissue type in a live bird. |
| | Can they penetrate cells of the body and what is the effect? | Can penetrate the cell and interfere with the normal functioning of the cell such as the secretion of saliva, |
| | Can they feed on dead birds and increase in numbers? | They can survive in a dead bird but cannot multiply themselves. |
| | How can they survive outside the body? | As long as they are protected from sunlight or adverse conditions such as dryness, they will die. |
| | Name three ways in which they can be spread to infect healthy birds | Drinking water. Carried by flies. Carried by people on their clothes. Carried on feathers or dust. |
| **Bacteria** | How do they multiply? | Reproduce by forming spores in dead animals or bedding material |
| | Can they penetrate cells of the body and what is the effect? | Bacteria attack cell membranes to cause infections |
| | Can they feed on dead birds and increase in numbers? | Use organic matter and uric acid as nutrients. |

| | | |
|---|---|---|
| | How can they survive outside the body? | Protected by a membrane that surrounds the bacterial body |
| | Name three carriers by which bacteria can be spread to infect healthy birds. | People. Rodents. Wild birds. |
| **Error! Reference source not found.Protozoa** | How do they multiply? | Reproduce in intestinal lining, cause bleeding of tissues. Reproductive cells, called “oocysts” are excreted in faeces |
| | Can they penetrate cells of the body and what is the effect? | Only penetrate the tissue of intestinal lining, not into cells, cause bleeding of tissue |
| | Can they feed on dead birds and increase in numbers? | Can’t reproduce in dead birds. |
| | Can they survive outside the body? | Very hardy organisms, survive in soil for months. |
| | | |
| | Name the most important way in which they can be spread to infect healthy birds | Underneath the boots that people wear and when foot baths are not containing active disinfectants |
| **Fungi (mould)** | What is fungi? | Primitive plants. |
| | How does it multiply? | By means of spores formed. |
| | What does it need to multiply? | Any organic damp material such as feed, bedding material and dust. |
| | What negatives effects does mould growths have on chickens? | Deposits poisonous substances, mycotoxins, during growth. Mycotoxins suppress growth and immune development. |