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In the previous block we discussed the recent animal welfare frameworks such as five freedoms, five domains and welfare quality criteria for understanding the needs and wants of animals in a scientific way. We also discussed their advantages and limitations. The purpose of this block is to make you understand the five freedoms in detail viz., definitions of each of the five freedoms, major issues involved along with the most appropriate methods for assessing these freedoms. Case studies are provided to illustrate how a scientific understanding of the underlying problem in the five freedoms has led to a solution.

UNIT 8, **Freedom from Hunger, Thirst and Malnutrition** delineates the concepts of hunger, thirst and malnutrition along with their assessment methods.

UNIT 9, **Freedom from Thermal and Physical Discomfort** focuses on the concept and different forms of thermal and physical discomforts along with their assessment methods.

UNIT 10, **Freedom from Pain, Injury and Disease** describes the concepts and definitions of pain, injury and disease along with sources, issues and assessment of pain.

UNIT 11, **Freedom to Express Normal Behaviour** deals with the concept, issues and assessment methods of normal behaviour.

UNIT 12, **Freedom from Fear and Distress** outlines the concepts and definitions of fear and distress along with assessment methods of fear and distress.
UNIT 8  FREEDOM FROM HUNGER, THIRST
AND MALNUTRITION

Structure

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8.1 LEARNING OUTCOMES

a) Knowledge and Understanding: After studying this Unit you will be able to:
   ● Understand the definitions of hunger and thirst.
   ● Explain the principles of assessing hunger and thirst.

b) Practical and Professional Skills: After studying this Unit you will be able to:
   ● Discuss how hunger and thirst affects animal welfare with scientific rationality.
8.2 INTRODUCTION

Dear Learner,

In Unit 7, the Five Freedoms were introduced as a framework for understanding the needs and wants of animals in a scientific way. We also discussed their advantages, limitations and developments since the Five Freedoms. In this Unit, we will consider the first of the Five Freedoms, and the means to achieve them as ‘freedom from hunger, thirst and malnutrition by ready access to fresh water and a diet to maintain full health and vigour’.

In the following sections, definitions of each of these states will be provided and discussed. Major issues involved are reviewed along with the most appropriate methods for assessing these states. A case study is provided to illustrate how a scientific understanding of the underlying problem has led to a solution. For the state of hunger, a broader issue is discussed in detail.

8.3 HUNGER

8.3.1 Concepts and Definitions

Access to food is a basic animal need. As stated in Unit 7, hunger can be defined as the state experienced when the animal has not been able to meet its nutritional requirements. Hunger is associated with an increasing motivation to find food and eat. Hunger can be short-term or chronic long-term:

a) The short-term hunger drives an animal to seek the next meal
b) Chronic long-term hunger occurs when an animal is chronically undernourished.

This does occur on farms under some specific management conditions (see section on Issues below). Farmers and animal owners should ensure that sufficient feed is provided to the animal to cover its basic daily needs (this is known as the maintenance allowance). There are states in which animals will have additional requirements, such as when they are growing, pregnant or lactating. Growing animals will have additional requirements above maintenance, pregnant animals have additional requirements associated with the growing foetus and the lactating female animal with milk production.

8.3.2 Balanced Feed vs. Animal Welfare

Animals require a balanced diet that includes protein, carbohydrate, fats and minerals and micronutrients. ‘Specific’ hungers also exist for particular nutrients like salt. Avoiding hunger involves providing animals with adequate feed, in an accessible manner. The following are the issues to consider:

a) Feed quantity, quality and diet formulation
b) Feeding patterns of animals and
c) Access to feed.

a) Feed Quantity, Quality and Diet Formulation:

There has been a great deal of research into animal nutrition, which has aimed to develop diets to provide for the dietary requirements of the species,
age, lactation or reproductive state of livestock. In many production systems, food intake is directly linked to growth and productivity, such as growth in broiler chickens and pigs, and milk yield in dairy cows, so farmers generally are well aware of the need to provide animals with sufficient feed. Feed quality is also important. Crop residues are important sources of animal feed for smallholders. However, it is important to ensure that there is sufficient carbohydrate in these residues. Digestibility of crop residues is also important (Box 8.1).

**Box 8.1: Crop Residues**

Crop residues are the abundantly available feedstocks that are obtained after crop harvesting. They are of two types mainly:

- Straw – obtained after harvest of fine grains like rice, wheat, oat etc.
- Stover – obtained after harvest of coarse grains like maize, sorghum, millets etc.

Globally nearly 4 billion metric tons of crop residues are available for feeding to livestock. In India alone nearly 100 million metric tons each of rice straw, wheat straw and sugarcane bagasse crop residues are available, which are otherwise unfit for human consumption.

Cereal crop residues have the following limitations:

- Low feeding value - poorly available nitrogen, low digestibility with lack of useful minerals
- Low voluntary intakes - around 1.5-2 kg/100 kg mature body weight

Despite the above limitations, they constitute and continue to be an important feed resource for sustainable dairy production in the developing world, as energy-protein malnutrition among livestock is a serious problem in these countries. Straws of legume crops have generally better nutritive value, forage quality and thus are nutritionally superior to cereal straws. Stovers have better nutritional quality than straws with respect to intake and digestibility. Straws and stovers are generally used to feed low producing animals or can be used as a source of bulk in the high producers’ ration to fulfil their appetite, can help correct physically effective fibre shortage for milk fat synthesis in high concentrate feeding systems and may beneficially provide additional heat increment during cold stress conditions.

*Source: Mahesh and Mohini (2014)*

**b) Feeding Patterns of Animals:**

Typically, animals do not eat their daily requirement in just one bout of feeding, but choose to eat in smaller portions or meals, just as humans do. The timing of these meals typically relate to the light: dark cycles and the availability of feed within these times. In intensively managed systems, such as for cattle, pigs and poultry, feeding patterns revolve around the time that feed is delivered, even if feed is available ad libitum. Animals are motivated to access fresh feed, as the quality may be slightly higher. In ruminants, such as cattle and sheep, the meal pattern distribution across the day is driven by the need to maintain appropriate rumen function, so periods of feeding are interspersed with periods of rumination.
In animals at pasture, the major grazing periods occur early in the morning (including dawn) and in the late afternoon/evening (including dusk). The period of grazing at dusk is the most intense, and most herbage is ingested in this period. This is thought to reflect the fact that the plants have accumulated carbohydrates via photosynthesis over the day, so grass nutritional quality is highest at dusk. Where the grazing is poor, animals may graze for longer or more frequent periods. In hot climates, grazing may occur at night. Cows may spend 8-10 hours grazing per day. Horses graze 50-80% of the 24 hour period. Sheep can graze for up to 15h/day, but variation occurs in all species dependent on:

- Grazing quality
- Body condition status
- Distance to water etc.

c) Access to Feed:

Ideally, all animals should be able to access the feed provided whenever they choose. In unrestricted grazing animals, access to feed can be limited by the amount of grazing or browsing material available. However, following issues are to be noted from animal welfare perspective for intensively housed animals:

- Intensively housed or managed animals are typically fed from troughs, bins or feed hoppers, care must be taken to allow all animals to get access to sufficient feed each day.

- In growing pigs and cattle, where animals have ad libitum access to feed, they are typically fed in long troughs. In some housing designs, there can be restrictions in the length or size of the trough space that can be provided.

- In addition, social animal prefer to feed at the same time, a phenomenon known as social facilitation. This preference results in all animals coming to the feeders when fresh feed is delivered, which can result in competition between animals if there is not sufficient space for all animals to feed together.

- Individuals low in the dominance hierarchy or ‘pecking order’ can experience aggression when they try to access feed, which causes an increase in stress and may cause injury. These low ranking individuals have to wait until the dominant animals have finishing feeding. In situations with very poor feeder space, the lower ranking animals may not be able to access sufficient feed each day. The design of the feeders or management of feeding can reduce aggression (Fig. 8.1 and 8.2).

- The presence of dividers or head bails on feeders prevents animals displacing others from the feeder. Providing ad libitum feed, or feeding two or more times per day will allow animals more unrestricted access.
Before we proceed, please complete activity 1.

**Activity 1 (Visit):** Visit a nearby dairy farm and discuss with the farm supervisor about different issues related to feeding vis-à-vis animal welfare. Compare their views with the one given above and write your observations on the following:

a) Feed quantity, quality and diet formulation:

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b) Feeding patterns of animals:

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c) Access to feed:

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Check Your Progress 1

Note:  a) Use the spaces given below for your answers.
       b) Check your answer with those given at the end of the unit.

1) How can hunger be described?
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2) Write the difference between short-term and long-term hunger.
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3) What is a balanced diet?
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4) What are the feed related issues to consider in avoiding hunger?
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5) Why is the period of grazing at dusk the most intense?
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   ......................................................................................................................
6) Write the approximate grazing hours / day for the following animals
   a) Cows : .................................................................
   b) Horses : .............................................................
   c) Sheep : ..............................................................

7) What factors influence grazing time?
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8) In animals kept in groups, poor access to feeders can cause hunger. Explain how this might be avoided.
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8.4 ASSESSMENT OF HUNGER

Hunger can be assessed scientifically using the following methods:
1) Simple weighing of animals
2) Body condition scoring system
3) Behaviour studies (e.g. Increased willingness to feed, feeding motivation, distance willing to travel to feed etc).
4) Physiological indictors

8.4.1 Simple Weighing of Animals

Hunger caused by long-term under-nutrition results in loss of bodyweight. Therefore, weighing animals regularly using a calibrated weigh-scale is one simple method of determining that an animal is not receiving sufficient feed. However, weighing animals is not always practiced on farms and inadequate nutrition can lead to slow growth. In some welfare assessment schemes, the age of piglets at weaning is used as an indicator of the quality of feeding on a farm.

8.4.2 Body Condition Scoring System

Long term hunger also causes a loss of body tissue and fat, or ‘body condition’. The regular assessment using a scoring system can allow a loss of body condition in animals to be detected. Body condition scoring systems have been developed for adult pigs, cattle, horses, goats and sheep. For some species, e.g. horses, this can be carried out by visual inspection. However, for species such as sheep the
Five Freedoms

The presence of a woolly fleece means that body condition scoring must be done by manual palpation of individual animals. A system for scoring dairy cattle is shown in Box 8.1, and Figures 8.2 a-c show a system for sheep, both involving manual palpation.

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>The individual spinal processes are sharp to the touch and easily distinguished</td>
</tr>
<tr>
<td>2</td>
<td>The spinous processes can be identified individually when touched, but feel rounded rather than sharp</td>
</tr>
<tr>
<td>3</td>
<td>The spinous processes can only be felt with very firm pressure and the areas on either side of the tail head have some fat cover</td>
</tr>
<tr>
<td>4</td>
<td>Fat cover around the tail head is easily seen as slight mounds, soft to the touch. The spinous processes cannot be felt.</td>
</tr>
<tr>
<td>5</td>
<td>The bone structure of the animal is no longer noticeable and the tail head is almost completely buried in fatty tissue.</td>
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</tbody>
</table>

A description of body condition scoring in sheep has been described by researchers at SAC, Scotland. The technique involves firstly using the tips of the fingers to assess the level of fat cover over the spine. The degree of sharpness or roundness of the lumbar vertebrae indicates the amount of fat cover. Then the prominence and degree of fat cover over the horizontal processes of the spine and the amount of muscle and fat under the ends of these bone can be assessed. By pressing the fingers into the area between the vertical and horizontal processes, the extent of the eye muscle and its fat cover can be examined. A scale from 1 to 5 can be assigned to each animal based on this assessment technique.

8.4.3 Behaviour Studies

In research settings, hunger can be assessed in a number of ways through animal behavioural studies. The experience of hunger can be expressed in an increased willingness to feed, but also to perform behaviours that will give access to feed. Thus, hunger can be assessed by giving an animal access to feed, and measuring the total amount of feed it consumes or the speed at which it eats. Feeding motivation can also be measured by requiring the animal to expend time or energy to gain access to feed. Studies have used long runways or passages to force animals to travel some distance to eat. The distance they are willing to travel, and the speed of movement can be used as indicators of hunger. In other studies, animals must push through past a weighted door or repeatedly press a button to gain access to feed. The maximum amount of weight tolerated, or button-presses made, is an indicator of feeding motivation.

8.4.4 Physiological Indicators

There are also physiological indicators of hunger. Body glucose levels are reduced in a hungry animal. Other indicators of hungers can be assessed from a blood
sample. Beta hydroxybutyrate and non-esterified fatty acids are commonly used indicators, particularly in late pregnant animals where they can be used in management to prevent metabolic diseases.

8.5 HUNGER SPECIFIC ISSUES

Conflict between The Five Freedoms identifies freedom from hunger as a basic ‘right’ of animals. However, there are specific situations in modern farming systems where access to feed is deliberately restricted, with the result that animals will experience hunger.

Example 1: A major one is the case of food restriction in broiler breeders. Modern fast-growing genotypes of broilers grow very quickly, and can reach their required slaughter-weight at as little as 5-6 weeks of age. Selection for this fast growth rate is accompanied by increased appetite and high feeding motivation. However, the cockerels and hens that are the parental stock (known as broiler breeders) also grow at this fast rate, but must be reproductively functional throughout their first year of life. If they are fed to appetite, they will grow at the rate of the broiler chicken intended for slaughter, but as they live longer, become obese and suffer leg bone pathology and thermal discomfort. It is necessary to restrict the amount of feed supplied to these animals by 30-50% of their *ad libitum* intake for their growing period, with a lower restriction applied during the laying period. A number of studies have shown that this practice leads to high levels of feeding motivation. These birds will eat 3 times more than birds that are not feed restricted in this way.

Example 2: A similar situation occurs in breeding sows. Again, modern pig genotypes have been selected for fast growth, and the appetite for feed in growing animals matches this growth rate. But as for broiler chickens, the animals destined for breeding stock also have this high motivation to feed. This means that these animals must be feed-restricted in order that they do not become too fat and achieve reproductive fitness.

This is a clear case where there is conflict in attempting to fulfil the five Freedoms. Food restricted broiler breeders are clearly experiencing hunger, but to allow them unrestricted access to feed would not allow them to experience the 3rd freedom, ‘Freedom from pain, injury and disease’. To try to resolve the problem, current research is exploring the use of diets high in fibre or other bulky substances, or the use of appetite suppressant substances. From a welfare point of view, the use of broiler and pig genotypes that do not have the high levels of growth, and whose parent stock do not require feed restriction would be preferable, but this would compromise productivity.

Before we proceed, please complete activity 2.

**Activity 2 (Hunger Case Study & Visit):**

a) **Hunger Case Study- Design of Feeders for Pigs:** Growing pigs that are housed in groups are generally observed to feed together. When fresh food is delivered, it is common to observe all pigs eating or attempting to eat. Where there is open access to the feed trough, and food restriction, there may be intense competition and fighting for access to the feed. In many codes of recommendation, it is stated that there should be enough
trough space to allow all pigs to feed at the same time. In theory, the minimum amount of trough space that a single pig should occupy is equal to the width of its shoulders. Researchers showed that shoulder width can be calculated according to the following formula:

\[ \text{Width} = 0.065 \times \text{liveweight}^{0.33} \]

However, studies by Baxter in the 1980s established that even when groups of pigs were provided with a space allowance of 9% greater than the sum of the shoulder widths, pigs only were able to eat together for 24% of the feeding time, as a result of aggression at the trough. A pig was displaced every 2 mins from the feed trough. The pigs that were displaced were typically the sub-ordinate animals. Further experimentation showed that including head bails or dividers on the feed trough reduced the aggression and while no aggression at all was shown when pigs were fed in a design that included both head and shoulder dividers. Furthermore, less food was wasted in the trough designs that had the dividers between the pigs. Studies carried out in Canada showed that much of the feed is wasted when pigs fight over feed. The using of dividers between animals or higher space allowances at the feeder will improve feed intake for all animals, particularly the smaller or sub-ordinate animals and reduce feed wastage. It is now very common to see dividers on pig feeders or on feed troughs. Further studies investigated pig’s preferences for the elevation of the feed trough. It was found that pigs prefer to eat from feeders that are at or slightly above ground level.

b) **Visit:** Visit a nearby pig farm and discuss the above case with the farm supervisor. Observe feeding space and feeding behaviour of pigs in the farm. Write your remarks:

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Check Your Progress 2

Note: a) Use the spaces given below for your answers.
   b) Check your answer with those given at the end of the unit.

1) Name different methods of assessing hunger.

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2) How does weighing animals regularly help in detecting hunger caused by long-term under-nutrition?

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3) What is the rationale behind hunger assessment using body condition scoring?

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4) Write one animal behaviour example through which we can assess hunger.

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5) Name the physiological indicators of hunger.

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8.6 THIRST

8.6.1 Concepts and Definitions

As stated in the Unit 7, thirst is the experience caused by the lack of adequate water. Like access to feed, access to water is also a basic animal requirement. All animals required daily access to sufficient water. All animals require water:

- for normal tissue and metabolic functioning
- to maintain body temperature through transpiration
- for the maintenance of mineral homeostasis
- as a carrier in the removal of metabolic end products such as urea.

Estimates of the daily water requirement of some of the major livestock species are shown in Box 8.2.

<table>
<thead>
<tr>
<th>Box 8.2: Typical Daily Water Requirements of Animals</th>
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<tbody>
<tr>
<td>Species</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>1. Dairy cows</td>
</tr>
<tr>
<td>2. Buffalos</td>
</tr>
<tr>
<td>3. Grower pigs</td>
</tr>
<tr>
<td>4. Pregnant sows</td>
</tr>
<tr>
<td>5. Laying hens</td>
</tr>
<tr>
<td>6. Broiler chicken</td>
</tr>
<tr>
<td>7. Horses</td>
</tr>
</tbody>
</table>

As well as the appropriate quantity of water, the water must be clean and fresh. Poultry have been shown to avoid drinking when the water contains high levels of calcium. High levels of zinc and nitrate will also depress drinking. Cows may refuse dirty or contaminated water. In pigs, drinking from water bowls is reduced when there is a build-up of debris from feed collected at the bottom of the bowl. Beef cattle have also been shown to prefer water with low levels of minerals. The NRC of the United States has developed a quality scoring system for water
quality for cattle that takes into account odour, physiochemical attributes (pH, dissolved solids, dissolved oxygen, hardness), the presence of toxic compounds, mineral composition and presence of microbes and contaminants. The last two factors are considered the most detrimental to quality of the drinking water. Cleaning out troughs and drinkers on a regular basis is important to ensure that animals will drink freely.

Water consumption depends on the following factors:

1) Ambient temperature and humidity
2) Animal status – dry animal, pregnant, lactating etc
3) Dryness of the feed (e.g. Animals grazing moist grass will need less water than animals being fed a dry concentrate diet).
4) Distance from the grazing area to the water troughs also affects drinking behaviour, with animals visiting less often when distances are long.
5) In housed animals, water consumption is associated with feeding periods (e.g. peaks of water consumption occur immediately before and after food delivery).
6) Animals require more water in high temperatures, as many animals use evaporative cooling to reduce their heatload (i.e. they sweat to cool down). This means that increased water must be provided during hot weather.
7) In very cold weather, low water temperatures may cause animals to avoid drinking the quantities they drink under normal temperatures.

Provision of water is important for dairy cattle, because milk is nearly 85% water, and a lack of water can depress milk yield. Holstein dairy cows drink at least 60L per day, and can drink up to 14 L per minute. For cattle and pigs, the water flow rate is an important factor in ensuring that sufficient water is available to the animals, particularly when peaks of water consumption are associated with feeding periods. Low flow rates will mean delays in trough refilling or poor intakes through nipple drinkers for pigs. Performance was lower in sows which had a flow rate of 70ml/min compared to sows with drinkers on 750ml/min, indicating the importance of water flow-rate. Water tanks or bowsers are useful when the water is not on a piped system. For dairy cows, it is recommended that there is space for 10% of the herd to drink at once. Each cow needs 70cm of trough space and the rim of the trough should be 75cm above the ground. For pigs up to 35kg, one water nipple drinker per 10 pigs is recommended, with up to 15 pigs for nipple drinker for older animals (Figures 8.3 a-c).
8.7 ASSESSMENT OF THIRST

Lack of water causes dehydration. Dehydration causes a loss of fluid in the skin and it becomes less elastic. Thirst can be assessed scientifically using the following methods:

1) Skin tent test
2) Inspecting the mucous membranes
3) Behavioural test
4) Welfare Quality protocols

8.7.1 Skin Tent Test

Veterinarians commonly used the ‘skin tent’ test to detect dehydration in animals. The skin on the neck or thorax of the animal is pinched between the thumb and forefinger and then released. In animals in a normal state of hydration, the skin moves back to its normal position almost immediately. The longer the skin takes to return to normal, the more dehydrated the animal is.

8.7.2 Inspecting the Mucous Membranes

Inspecting the mucous membranes (gums and inside the nostrils) is another method of detecting dehydration. These areas should be moist. The eyes of a dehydrated animal may also appear sunken into the eye sockets.

8.7.3 Behavioural Test

By the time the animal shows a positive response to the ‘skin tent’ test, or shows dry mucous membranes or sunken eyes, it is quite dehydrated and may require veterinary intervention. However, there are currently few reliable measures available that are more sensitive to lower levels of dehydration. A study in Belgium and Brazil showed that broiler chickens deprived of water for 12 hours drank more after the deprivation period than non-deprived animals. The experiment was repeated with a comparison of 0 and 6 hours. Only birds in Brazil showed more drinking after 6 hours deprivation, while the birds in Belgium did not, suggesting that high ambient temperatures play a role in the motivation to drink.
8.7.4 Welfare Quality Protocols

Because of this lack of a sensitive test, most welfare assessment protocols assess the quantity or space allowance of the drinkers available relative to the number of animals, and the water flow rate and the cleanliness of the water. For instance the Welfare Quality protocols that cover, pigs, dairy and beef cattle, and poultry, considers the cleanliness of the water and the functionality of the drinkers. For cattle, the flow rate is also assessed.

Before we proceed, please complete activity 3.

Activity 3 (Case Study & Visit):

a) Thirst Case Study- Designing Water Troughs for Dairy Cattle

As mentioned above, drinking behaviour is very important for dairy cattle, as their milk yield is directly dependent on their level of water consumption. However, there is a wide variation in the ways in which water is presented in troughs. Perhaps surprisingly, cattle have been shown to prefer drinking from a trough rather than from an open stream. A group in Brazil (Universidade Federal de Santa Catarina) conducted a number of studies into the design of water troughs for dairy cattle, to determine what features of the troughs best promoted drinking behaviour. In their first study, they investigated the water consumption and preference of dairy cattle for different sizes of water trough. They found that the cows preferred larger to smaller troughs, and drank more water from the larger troughs, with the largest surface area. They then investigated the preference for the height and depth of water troughs. Cows drank more from troughs that were 60cm from the ground compared to the one that was 30cm from the ground. The water depth did not affect preference or water consumption. In a further study, this group also tested the effect of providing shade over the water trough, but this did not affect the amount of water consumed.

b) Visit: Visit a nearby dairy farm and discuss the above case with the farm supervisor. Observe water consumption and preference of dairy cattle for different sizes of water trough drinking in the farm. Write your remarks:

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Check Your Progress 3

Note:  a) Use the spaces given below for your answers.
       b) Check your answer with those given at the end of the unit.

1) Give a definition of thirst.
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   ......................................................................................................................

2) Why do animals require water?
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   ......................................................................................................................

3) Write the daily water requirement for the following species of animals:
   a) Dairy cows : ..................................................................................
   b) Buffalos : ..................................................................................
   c) Grower pigs : ..................................................................................
   d) Pregnant sows : ..................................................................................
   e) Horses : ..................................................................................

4) What are the quality indicators for drinking water?
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5) What is the skin tent test?
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6) What feature of a water trough is the most important for cattle: the surface area or the depth?
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8.8 MALNUTRITION

Malnutrition, in all its forms, includes under-nutrition (wasting, stunting, and underweight), inadequate vitamins or minerals, overweight, obesity, and resulting diet-related non-communicable diseases. Malnutrition can occur when animals are not provided with the right quality of food to meet their specific needs. This differs from hunger in that the animals may be able to eat a sufficient quantity of food to be satiated, but the quality of the food is insufficient. This may be, for example, because the diet is inadequate for protein, even if it contains sufficient carbohydrate or fat, or because important micronutrients or trace elements are not present. The requirements of animals can vary during different life stages, from the very rapid growth of young animals, to the specific needs of pregnant and lactating animals. Thus malnutrition can occur due to lack of knowledge, as well as an inability to provide a diet of sufficient quality.

8.9 LET US SUM UP

- The Five Freedoms provide a framework to determine what animals need from their environments.
- We can define hunger as the state experienced when an animal has not been able to meet its nutritional needs.
- The quantity of feed or pasture grass provided for the animal is clearly important, but feed quality is also important in providing appropriate nutrition for animals.
- In animals kept in groups, it must be ensured that all animals have access to adequate feed.
- Hunger is typically assessed on farms by scoring body condition. In research, the motivation to feed can be assessed by various methods.
- Thirst will be experienced when the animal has not been able to ingest adequate water.
- Water quality is also important, as water intake is reduced when quality is poor.
- Long-term thirst causes dehydration, and this can be assessed using the skin-tent test.
- Animals should have access to adequate water troughs, which are kept clean and which have good flow rates.
8.10 KEYWORDS

*Ad libitum Feeding*: This means that the diet is available at all times and thus, animals can feed whenever they choose.

*Feeding Patterns*: Animals do not typically eat their daily ration in a single bout of eating. Animals on an *ad libitum* diet will typically choose to eat several smaller meals per day. The daily scheduling of these meals is referred to as feeding patterns.

*Hunger*: The state experienced when the animal is not able to meet its nutritional requirements. Hunger is associated with high motivation to seek food and eat.

*Maintenance Allowance*: Feed provided to the animal to cover its basic daily needs is known as maintenance allowance.

*Restricted Feeding*: This refers to restricting the amount of food offered to an animal while still ensuring nutritional adequacy.

*Rumination*: Also called cud-chewing, this is the process by which ruminants (e.g., cattle, buffalo, sheep, goats) regurgitate previously consumed feed and masticate it a second time. They usually spend more time chewing during rumination than they do when they eat.

*Thirst*: State experienced when the animal has not been able to ingest adequate water.

*Water Quality*: Water for animals must be clean and fresh. It must be free of microbial and chemical contaminants and dirt.

8.11 REFERENCES AND FURTHER READING


Websites:
Agricultural and Horticulture Development Board (UK): www.ahdb.org.uk

8.12 SELF ASSESSMENT EXERCISES

1) Discuss the issues involved in providing animals with adequate feed in an accessible manner.

2) What is body condition scoring, and how can it be used to assess hunger?

3) How can behaviour studies help in the assessment of hunger?

4) In animals kept in groups, poor access to feeders can cause hunger. Explain how this might be avoided.

8.13 ANSWERS / HINTS TO CHECK YOUR PROGRESS

Check Your Progress 1

1) Hunger can be described as the state experienced when the animal has not been able to meet its nutritional requirements. Hunger is associated with an increasing motivation to find food and eat.

2) The short-term hunger drives an animal to seek the next meal, whereas chronic long-term hunger occurs when an animal is chronically undernourished.

3) Animals require a balanced diet that includes protein, carbohydrate, fats and minerals and micronutrients.

4) The issues to consider are: feed quantity, quality and diet formulation; feeding patterns of animals; and access to feed.

5) The period of grazing at dusk is the most intense and most herbage is ingested in this period. This is thought to reflect the fact that the plants have accumulated carbohydrates via photosynthesis over the day, so grass nutritional quality is highest at dusk.

6) Approximate grazing hours / day: (a) Cows – 8-10 hours; (b) Horses – 12-19 hours; (c) Sheep – Up to 15 hours

7) Grazing time variation occurs in all species dependent on grazing quality, body condition status, distance to water etc.

8) Problems of access to the feeders can arise when the size of the feed trough is small compared to the number of animals in the group. Access can be improved by increasing the length of the feeder or by using partitions or
barriers between animals to prevent them from displacing neighbours from the feeder.

Check Your Progress 2

1) Hunger can be assessed scientifically using methods like Simple weighing of animals, Body condition scoring system, Behaviour studies and Physiological indicators.

2) Hunger caused by long-term under-nutrition results in loss of bodyweight. Therefore, weighing animals regularly using a calibrated weigh-scale is one simple method of determining that an animal is not receiving sufficient feed.

3) Long term hunger causes a loss of body tissue and fat, or ‘body condition’. The regular assessment using a scoring system can allow a loss of body condition in animals to be detected.

4) Hunger can be assessed by giving an animal access to feed, and measuring the total amount of feed it consumes or the speed at which it eats. Feeding motivation can also be measured by requiring the animal to expend time or energy to gain access to feed.

5) Body glucose levels, Beta hydroxybutyrate and non-esterified fatty acids are commonly used physiological indicators of hunger, which can be measured by blood sampling.

Check Your Progress 3

1) Thirst is the experience caused by the lack of adequate water.

2) Animals require water: for normal tissue and metabolic functioning; to maintain body temperature through transpiration; and for the maintenance of mineral homeostasis

3) Daily water requirement for: (a) Dairy cows: 60 L / day; (b) (c) Buffalos : 65-70 L / day; (c) Grower pigs : 8-12 L/day ; (d) Pregnant sows : 12-25 L/day; (e) Horses: 20-40 L/day.

4) The scoring system indicators for water quality are odour, physiochemical attributes (pH, dissolved solids, dissolved oxygen, hardness), the presence of toxic compounds, mineral composition and presence of microbes and contaminants.

5) Veterinarians commonly used the ‘skin tent’ test to detect dehydration in animals. The skin on the neck or thorax of the animal is pinched between the thumb and forefinger and then released. In animals in a normal state of hydration, the skin moves back to its normal position almost immediately. The longer the skin takes to return to normal, the more dehydrated the animal is.

6) Studies have shown that surface area is the most important feature. Animals will choose troughs with larger surfaces areas and will drink more from them.
UNIT 9  FREEDOM FROM THERMAL AND PHYSICAL DISCOMFORT

Structure
9.1 Learning Outcomes
9.2 Introduction
9.3 Discomfort
   9.3.1 Concepts and Definitions
9.4 Physical or Lying Comfort
9.5 Thermal Comfort
   9.5.1 UCT vs. LCT
9.6 Assessment of Discomfort
   9.6.1 Assessment of Physical or Lying Comfort
   9.6.2 Assessment of Thermal Comfort
9.7 Let Us Sum Up
9.8 Keywords
9.9 Bibliography and Further Reading
9.10 Self Assessment Exercises
9.11 Answers / Hints to Check Your Progress

9.1 LEARNING OUTCOMES

a) Knowledge and Understanding: After studying this Unit you will be able to:
   - Understand the concept and definitions of discomfort.
   - Explain the principles of assessing discomfort.

b) Practical and Professional Skills: After studying this Unit you will be able to:
   - Discuss how discomfort affects animal welfare with scientific rationality.

9.2 INTRODUCTION

Dear Learner,

In Unit 8, we discussed the first of the Five Freedoms, and the means to achieve them as ‘freedom from hunger, thirst and malnutrition by ready access to fresh water and a diet to maintain full health and vigour’. In this Unit, we will consider the second of the Five Freedoms i.e Freedom from discomfort by providing an appropriate environment including shelter and a comfortable resting area. In the following sections, definitions of each of these states will be provided and discussed. Major issues involved in discomfort are reviewed along with the most appropriate methods for assessing discomfort states. A case study is provided to illustrate how a scientific understanding of the underlying problem has led to a solution.
9.3 DISCOMFORT

9.3.1 Concepts and Definitions

Discomfort is a feeling of being uncomfortable physically or mentally, or something that causes this. Animals experience discomfort when some aspect of their environment is not optimal. Stimuli or situations that cause discomfort may lead to pain and distress if allowed to continue or intensify. Many of the factors causing discomfort for animals are part of the overall climatic or housing environment, and so many interpret the ‘freedom from discomfort’ as being to do with the environment and housing of animals. For instance FAWC (Farm Animal Welfare Council, UK), state that freedom from discomfort can be fulfilled by providing the animal with an appropriate environment including shelter and a comfortable resting area. However, it is worth remembering that discomfort can also be an issue with working animals where harnesses or other pieces of equipment may be poorly fitting, and where animals are overloaded.

Comfort from the living environment is of two types:
1) Physical / lying comfort
2) Thermal comfort

Let us discuss them in detail in the following sections.

9.4 PHYSICAL OR LYING COMFORT

Animals should be provided with a clean, dry and comfortable area to lie down. The opportunity to lie down is essential for health and welfare. Animals are reluctant to lie down in wet, muddy or dirty areas. In very poor conditions, they will only lie down when they become extremely fatigued. Fatigue induced by the lack of a good lying area causes high levels of stress, which can adversely affect health if experienced for extended periods of time.

Providing bedding material or a good lying substrate is the best way of ensuring that animals get adequate rest. A lying substrate such as sand can be used, but it must be able to be kept clean and dry. It is often more practical and preferable to provide bedding material on a solid surface, as this bedding material can be replaced when it becomes wet or dirty.

A good bedding materials characteristic includes:
- Should be comfortable to lie on
- Non-abrasive
- Non-slippery
- Highly absorbent, and
- Have low levels of mould or bacterial contamination.

**Knee-drop Test:** If a person can drop from standing to kneeling in comfort (the ‘knee-drop test’), this is a good indication that the bed is sufficiently comfortable for a cow.

Bedding should be provided in sufficient quantity to provide sufficient cushioning or deformability to prevent pressure on the animal’s body while lying. Different
types of bedding material that can be used for different species are summarised in Box 9.1.

**Box 9.1: Bedding Material for Different Species**

For pigs, cattle and sheep, many different types of straw, elephant grass, sawdust or wood shavings, or shredded paper can be used. Straw or other crop residues should ideally be free from mould or contaminants that may cause respiratory disease. Wood sawdust should not be dusty or have a sharp, abrasive quality. Wood shavings or rice husk are the preferred bedding for poultry. Locally available alternatives can be used if they met the criteria outlined above. Rubber mats or mattresses are often used in concrete-based cubicles for cows. It is preferable to also provide bedding on top of these mats.

The standing or feeding areas of the animal house are also important. In many housing systems for cattle and pigs, the floor is made of concrete or brick or other solid material. To maintain health and good welfare, passageways and standing areas should be cleaned regularly to prevent a build-up of manure. Manual systems can be used, such as cleaning by hand or with the blade of a tractor, but automatic systems are also extensively used. In areas where animals spend long periods standing, such as the feeding areas and the milking parlour collecting areas for dairy cattle, new research has shown that cow foot and leg health is improved when rubber floor covering is provided in these areas. However, it must be ensured that this rubber is not slippery.

Before we proceed, please complete activity 1.

**Activity 1 (Visit):** Visit a nearby livestock or poultry farm and discuss with the farm supervisor about different types of bedding materials being used by them. Assess the comfort levels to the livestock or poultry birds and write your observations.

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Check Your Progress 1

Note:  
a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) How can discomfort be described?

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2) In broader terms how can freedom from discomfort be fulfilled?

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3) Write the characteristics of a good bedding material.

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4) What is the Knee-drop Test?

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9.5 THERMAL COMFORT

Animals such as birds and mammals are normally capable of controlling their body temperature within a narrow range, known as the thermoneutral zone, that allows normal body functioning. This range is bounded by a lower critical temperature (LCT) and an upper critical temperature (UCT). When external environmental conditions move outside this range, animal will experience cold and heat stress and will use behavioural and physiological mechanisms to control body temperatures. A rise in core body temperature of 1.5°C or more may be considered to be hyperthermia. A rise of 4-5°C will almost always be fatal. Likewise, a fall in core body temperature of 1.5°C indicates hypothermia. Decreases of 5°C or more may not be fatal but will cause unacceptable levels of stress.
9.5.1 UCT vs. LCT

When the temperature rises towards and beyond the UCT, following behavioural mechanisms are used to dissipate heat:

1) Seeking shade or areas with a breeze to facilitate evaporative cooling.  
   Example: Pigs will wallow in mud or water in order to cool down.

2) Activity reduction  
   Example: It has been shown that chickens reduce the amount of time spent standing and walking when the environmental temperature rises above the UCT.

3) Water consumption is increased and feed consumption is reduced, as metabolising feed produces heat.

4) Physiological measures include panting and sweating to increase heat loss through evaporative cooling, and an increase in blood flow to uninsulated surface areas.

If these mechanisms are not successful in maintaining core body temperature within the desired range the consequences can be serious and may be fatal.

When temperatures fall below the LCT, the behavioural responses include:

1) Seeking warmer sheltered areas
2) Turning heads away from prevailing wind to minimise heat loss
3) Huddling with other groups members to reduce heat loss.
4) Physiological mechanisms include pilo-erection (raising the hair to increase insulation around the body)
5) Shivering and increasing metabolic rate to generate heat.

To support increased metabolic rate during extended periods of cold weather, additional feed is required.

A diagram of the relationship between the lower and upper critical temperatures (LCT and UCT) is presented in Fig 9.1

Fig. 9.1: Relationship between environmental temperature, thermo-neutral zone and cold and heat stress zones, showing the thermoneutral zone, the lower and upper critical temperatures (LCT and UCT) (Yousef 1985).
The LCT and UCT values vary with species, age and physiological state. Young animals have higher LCTs than older animals (i.e. are more susceptible to cold stress) while lactating females, because of the heat generated from milk production, have lower LCTs.

However, it is not only temperature that affects heat stress. Humidity also plays a role, as animals are less able to lose heat by evaporative cooling when the surrounding area is humid. The temperature humidity index (THI) has been developed and accounts for the combined effect of environmental temperature and humidity and is a useful way of assessing the risk of heat stress. It was originally calculated for humans, but has also been calculated for many of the livestock species. Figure 9.2 shows THI zones for temperate-breed dairy cattle.

![THI zones for dairy cattle](image)

**Fig. 9.2:** Relationship between temperature and relative humidity with THI zones of heat stress in cattle (modified after Armstrong 1994, J. Dairy Sci. 59, 2044-2050).

**Check Your Progress 2**

**Note:**

a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) What do you understand by the term thermoneutral zone?

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2) Differentiate between hyperthermia and hypothermia.

3) What is the temperature humidity index (THI)?

9.6 ASSESSMENT OF DISCOMFORT

Discomfort cannot be assessed directly, but can be assessed indirectly by looking for the consequences of poor comfort. The measures currently used are:

1) Assessment of physical or lying comfort
   a) Cleanliness
   b) Presence of injuries

2) Assessment of thermal comfort
   a) Quantifying the behavioural and physiological responses

Let us discuss them briefly.

9.6.1 Assessment of Physical or Lying Comfort

a) Cleanliness

If animals are forced to lie in wet or dirty lying areas, their coats, hair and general body surfaces will become dirty or encrusted with mud or bedding material. Scales have been developed to quantify the level of cleanliness, which range from clean through to very dirty. In some cases the extent of the dirty areas on the body are taken into account. Box 9.2 shows an example of a cleanliness score for cattle adapted from the UK meat Hygiene Service.

| Box 9.2: Cleanliness Score for Cattle (Source: UK Meat Hygiene Service) |
|---------------------------------|------------------|-------------------|
| **Score** | **Term** | **Description** |
| 1 | Dry | Clean with regards to faeces/dirt; very minor amounts of loosely adherent straw/bedding |
| 2 | Dry / damp | Light contamination faeces/dirt; small amount of loosely adherent straw/bedding |
b) Presence of Injuries

If the animal is forced to come into contact with abrasive or sharp concrete or metal objects in the lying, feeding or watering areas, they may develop hairless patches, rubs, swelling, abrasions and ultimately, skin lesions, in these areas. This may occur under the neck if the outside rim of the feeder is abrasive and on the hocks, legs and knees if the lying area is abrasive. When they are kept on wet litter, poultry may develop conditions known as footpad dermatitis and hock burn, which are necrotic lesions of the underside of the feet and on the hocks. Box 9.3 shows an example of a scoring system for footpad lesions.

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<tr>
<th>Score</th>
<th>Description</th>
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<tr>
<td>0</td>
<td>No lesions, no or very mild superficial lesions, slight discoloration on a limited area of the footpad, mild hyperkeratosis (thickening of the outer layer of the skin) or healed lesion.</td>
</tr>
<tr>
<td>1</td>
<td>Mild lesion, discoloration of the footpad, superficial lesions, dark papillae and hyperkeratosis</td>
</tr>
<tr>
<td>2</td>
<td>Severe lesion: epidermis is affected, ulcers or scabs, signs of haemorrhages or swollen footpads</td>
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Similar scoring systems have been developed to assess the severity of hock and knee lesions in a range of species. Many of these are documented in the Welfare Quality® welfare assessment protocols (see Further Reading section for web link).

9.6.2 Assessment of Thermal Comfort

As suggested above, quantifying the behavioural and physiological responses that animals make to heat and cold stress are key to identifying these conditions.

Thus animals that are experiencing heat stress will show (as typical for that species) over extended periods of time:

a) Excessive panting
b) Sweating, and
c) Salivation
Similarly, animals that are experiencing cold stress will show:

a) Shivering, and

b) Huddling

While these responses can be considered a normal corrective response if they occur only for short periods, where they occur over long periods, severe distress may be experienced. In more severe cases, body temperature will be raised or lowered outside the above the normal range for that species, age and metabolic state.

Before we proceed, please complete activity 2.

**Activity 2 (Case Study & Visit):**

**a) Case Study - Designing Transport Vehicles for Comfort of Animals**

In many parts of the world, animals are transported from their rearing farms to abattoirs (slaughter house) in large trucks or transport vehicles. Typically, animals are in close proximity to each other, and the overall space is small. Where air temperatures are high, these enclosed spaces may create thermal stress problems. As discussed above, animals generate heat, and when closely packed together, this heat cannot be lost to the surrounding air. Additionally, the respiration of many animals will increase the humidity of the surrounding area. In hot weather, the problem is exacerbated by animals attempting to lose heat by panting. In these conditions, deaths during transport can be significant. Extensive studies have shown that ventilation of these vehicles is the key issue. Air movement through the vehicle can remove heat and moisture, and allow animals to lose excess heat. Openings in the side of the vehicle can allow air to move through the animal containment areas, especially when the vehicle is moving. However, in hot temperatures, mechanical ventilation, using fans, is necessary. This is particularly important when a loaded vehicle is stationary. Research on the physics of air movement through transport vehicles has shown that air enters through the rear of the vehicle and exits from the front, behind the driver’s cab. This is because forward movement of the vehicle causes a low pressure area behind the vehicle. Air then moves forward over the animals and leaves through the front. This research suggests that the most effective way of ensuring adequate ventilation across the whole vehicle is to install extractor fans at the front of the vehicle and air vents at the rear. These guidelines have been used to design transport vehicles in the UK which have been effective in reducing animal deaths during transport (Taken from PB11260 – Please see further reading section for details).

**b) Visit:** Visit a nearby slaughter house and observe the designs of transport vehicles that are bringing animals from their rearing farms. Compare the design with the particulars given in the above case. Write your remarks on thermal comfort of the animals.

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Check Your Progress 3

Note:  
a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) Name the measures currently used to assess discomfort among animals.

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2) How do animals respond to heat stress and cold stress?

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3) How is the ‘freedom from discomfort’ interpreted practically?

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9.7 LET US SUM UP

- In practice, freedom from discomfort generally refers to the quality of the environmental conditions that animals are kept in. Often, this is taken to mean the thermal comfort and comfort around lying. Thus freedom from discomfort provides a framework to determine what animals need from their environments.

- Applying the freedom from discomfort principle is typically taken to mean providing the animal will a good physical environment.

- Long term experience of discomfort can lead to stress and injury.

- Providing bedding and lying surfaces will ensure lying comfort.

- Thermal comfort can be provided by providing adequate shelter or heating in cold conditions and ventilation or cooling mechanisms in hot conditions.

- In the next Unit we will discuss the freedom from pain, injury and disease.
9.8 KEYWORDS

**Discomfort**: Discomfort refers to a situation in which the physical environment is not appropriate or sufficient to meet the animals’ needs.

**Lower Critical Temperature**: The ambient temperature below which the rate of metabolic heat production of a resting thermo-regulating animal must be increased by shivering and/or non-shivering thermogenesis in order to maintain thermal balance.

**Thermo-Neutral Zone (TNZ)**: The range of ambient temperatures at which temperature regulation is achieved by only control of sensible heat loss, i.e. without changes in metabolic heat production or evaporative heat loss.

**Upper Critical Temperature**: The ambient temperature above which the evaporative heat loss of a resting thermo-regulating animal must be increased by thermal tachypnea (panting) or thermal sweating in order to maintain thermal balance.

9.9 BIBLIOGRAPHY AND FURTHER READING


Websites:

Agricultural and Horticulture Development Board (UK): www.ahdb.org.uk


9.10 SELF ASSESSMENT EXERCISES

1) Differentiate the behavioural mechanisms that are used during upper critical temperature (UCT) and lower critical temperature (LCT).

2) Discuss how temperature and humidity play the role in thermal discomfort of animals.

3) Explain with suitable examples the measures currently used to assess discomfort among animals.
9.11 ANSWERS / HINTS TO CHECK YOUR PROGRESS

Check Your Progress 1

1) Discomfort is a feeling of being uncomfortable physically or mentally, or something that causes this. Animals experience discomfort when some aspect of their environment is not optimal.

2) Freedom from discomfort can be fulfilled by providing the animal with an appropriate environment including shelter and a comfortable resting area.

3) A good bedding material: should be comfortable to lie on; non-abrasive; non-slippery; highly absorbent, and; have low levels of mould or bacterial contamination.

4) If a person can drop from standing to kneeling in comfort (the ‘knee-drop test’), this is a good indication that the bed is sufficiently comfortable for the cow.

Check Your Progress 2

1) Animals such as birds and mammals are normally capable of controlling their body temperature within a narrow range, known as the thermoneutral zone, that allows normal body functioning.

2) A rise in core body temperature of 1.5°C or more may be considered to be hyperthermia. Likewise, a fall in core body temperature of 1.5°C indicates hypothermia.

3) Temperature humidity index has been developed and accounts for the combined effect of environmental temperature and humidity and is a useful way of assessing the risk of heat stress.

Check Your Progress 3

1) The measures includes: Assessment of physical or lying comfort (Cleanliness & Presence of injuries) and Assessment of thermal comfort (Quantifying the behavioural and physiological responses).

2) The responses of animals for heat stress are excessive panting, sweating, and salivation. Similarly, animals that are experiencing cold stress will show shivering and huddling.

3) In practice, ‘freedom from discomfort’ generally refers to the quality of the environmental conditions that animals are kept in. Often, this is taken to mean the thermal comfort and comfort around lying.
UNIT 10  FREEDOM FROM PAIN, INJURY AND DISEASE

Structure
10.1 Learning Outcomes
10.2 Introduction
10.3 Pain, Injury and Disease
   10.3.1 Concepts and Definitions
   10.3.2 Classification of Pain
   10.3.3 Sources of Pain
10.4 Assessment of Pain
   10.4.1 Assessing Pain under Research Conditions
   10.4.2 Assessing Pain under Clinical Conditions
   10.4.3 Assessing Pain using Rating Scales
   10.4.4 Assessing Sickness Behaviour
10.5 Issues Associated With Pain
10.6 Let Us Sum Up
10.7 Keywords
10.8 Bibliography and Further Reading
10.9 Self Assessment Exercises
10.10 Answers/Hints to Check Your Progress

10.1 LEARNING OUTCOMES

a) Knowledge and Understanding: After studying this Unit you will be able to:
   - Understand the concept and definitions of pain, injury and disease.
   - Outline the main ways that pain, injury and disease can be assessed and provide examples of how animal welfare has been improved by consideration of pain assessment methods.

b) Practical and Professional Skills: After studying this Unit you will be able to:
   - Discuss how pain, injury and disease affect animal welfare with scientific rationality.

10.2 INTRODUCTION

Dear Learner,

In Unit 9, we discussed the second of the Five Freedoms, and the means to achieve them as ‘freedom from discomfort – by providing an appropriate environment’. In this Unit, we will consider the third of the Five Freedoms i.e freedom from pain injury and disease by prevention or rapid diagnosis and treatment. In the following sections, each of these will be defined and particular
issues in relation to the role they play in animal welfare will be discussed. Approaches to assessing these within an animal welfare context will be described with examples. A case study is provided to illustrate how a scientific understanding of the underlying problem has led to a solution.

## 10.3 PAIN, INJURY AND DISEASE

### 10.3.1 Concepts and Definitions

Pain is an everyday concept and a word used commonly to describe many different human experiences. Yet despite this familiarity it is a concept that provokes much philosophical and scientific debate. This debate grows more vigorous when the term is applied to animals. Pain is a subjective mental state, which involves strong aversive emotions. As a consequence of the inherent subjectivity of pain some people have either denied that it can be applied to animals, or – whilst acknowledging that animals may be capable of experiencing pain – have denied that animal pain is open to scientific assessment. However, if we choose to follow the scientific consensus and acknowledge that many animals are sentient then it follows that animals can experience pain, and inferences can be made about animal pain through careful observation and measurement of different components of biology.

The International Association for the Study of Pain (IASP) defines pain as:

> “an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage”.

Whilst considering the definition of pain it is important to discuss the related term ‘nociception’. In some cases these terms may be confused or used interchangeably; however they do mean different things. Nociception is the process whereby actual or potential tissue damage is detected (by specialist nerve cells, known as nociceptors) and signaled to the brain via the spinal cord. The brain then processes these signals, along with other information about bodily state, and produces the conscious aversive experience of pain.

### 10.3.2 Classification of Pain

A further aspect of terminology is the classification of pain according to:

- Location
- Type, and
- Timing

Different types of pains are differentiated and summarised in Box 10.1 for your understanding.

<table>
<thead>
<tr>
<th>Box 10.1: Classification of Pain</th>
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<tbody>
<tr>
<td><strong>a) Location</strong></td>
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<tr>
<td>• <strong>Somatic pain:</strong> This is associated with damage to the skin, muscle, bones or other soft tissues of the body.</td>
</tr>
<tr>
<td>• <strong>Visceral pain:</strong> This is associated with damage to the internal organs of the body</td>
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</table>
Beyond the simple difference in body location somatic and visceral pains have some distinctive features: visceral pain is poorly localized and provokes a more aversive emotional response than somatic pain.

<table>
<thead>
<tr>
<th>b) <strong>Type</strong></th>
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<tbody>
<tr>
<td><strong>Nociceptive pain:</strong> This is directly caused by tissue damage – thermal, mechanical or chemical – detected by nociceptors.</td>
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<tr>
<td><strong>Neuropathic pain:</strong> This is caused by nerve damage.</td>
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<tr>
<th>c) <strong>Time</strong></th>
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<tr>
<td><strong>Acute pain:</strong> This is pain which occurs at the time of injury.</td>
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<tr>
<td><strong>Sub-acute or Secondary pain:</strong> Following on from immediate acute pain is a stage of sub-acute or secondary pain associated with injury; for instance as a result of an inflammatory state caused by tissue damage.</td>
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<tr>
<td><strong>Chronic pain:</strong> This is often used, not simply to mean a pain experience that has continued for a lengthy period of time, but to describe pain states where the fundamental biology of the individual has changed, i.e. where pain is still felt after an injury has resolved.</td>
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### 10.3.3 Sources of Pain

Animals may experience pain from many different sources. Specifically listed under this Freedom are:

- **Injury, and**
- **Disease.**

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<tr>
<th>a) <strong>Injury</strong></th>
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<tr>
<td>Taken broadly the term injury can be considered to mean:</td>
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<tr>
<td>- Unintentional harm caused to the body of an animal (e.g. direct injury from the environment or another animal)</td>
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<tr>
<td>- Intentional injuries inflicted by humans as a part of management (for example: tail-docking, castration, de-horning or de-beaking).</td>
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</table>

<table>
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<tr>
<th>b) <strong>Disease</strong></th>
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<tbody>
<tr>
<td>In addition to being a common cause of animal pain, disease states may also impair animal welfare through other associated aversive emotions, including those associated with sickness behaviour and fatigue. The existence of disease states – with or without pain – therefore has direct relevance for animal welfare. Disease may be identified by the animal caretaker or formally diagnosed by a veterinarian. Whilst some disease states may have only minimal impact on welfare, often there is a clear effect. In the most extreme examples this includes death, either as a consequence of the disease processes or via humane euthanasia. In either case, death may be preceded by periods of sometimes severe suffering (which can be a combination of fear, stress, pain, discomfort etc). Non-terminal diseases also often impair welfare. One issue specific to disease responses is the occurrence of sickness behaviour, which is often associated with general low mood in humans and animals. Sickness behaviour is initiated by the innate immune response then orchestrated by the brain.</td>
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</table>
During inflammation various immunological messengers – such as cytokines and chemokines – are produced, which affect immunological, physiological and behavioural responses to a pathogen challenge. In part the physiological and behavioural responses aim to produce and preserve energy to fight sickness. Studies have shown that sickness behaviour is not simply a consequence of debility, where the animal is incapable of performing other behaviours, rather it should be considered an adaptive, organised, motivational state that conserves energy, avoids danger, promotes recovery, or avoids further disease transmission.

Before we proceed, please complete activity 1.

Activity 1 (Visit): Visit a nearby livestock or poultry farm and discuss with the farm supervisor about different types of diseases and associated animal welfare issues. Write your observations.

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Check Your Progress 1

Note: a) Use the spaces given below for your answers.
b) Check your answer with those given at the end of the unit.

1) Define pain.
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2) What is Nociception?
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3) Differentiate between somatic and visceral pains.
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4) What is sub-acute or secondary pain?
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5) Name two major sources of pain.
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6) Give examples for intentional injuries inflicted by humans as a part of management.
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7) What do you understand by the term ‘sickness behaviour’?
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10.4 ASSESSMENT OF PAIN

Assessing pain in animals is a challenging yet important task in animal welfare science and veterinary practice. Approaches to pain assessment in animals vary depending on the context. Under research conditions a range of detailed observations or measurements can be conducted to allow inferences to be made about animal pain experiences. Alternatively under practical field or clinical conditions different approaches are needed.

10.4.1 Assessing Pain under Research Conditions

Within veterinary research, practice or animal welfare, researchers may be interested in studying pain to:

1) Assess the painfulness of an injury or disease associated with a production system.

2) Compare the overall painfulness of different treatments.

3) Examine the impact of pain relief methods.

When addressing any of these questions, a range of different measurements may be used. Commonly a key component of such studies is the assessment of animal behaviour. Behavioural assessments of pain may range from simple responses (sometime reflexes) to sensory stimulation, through to assessment of more complex spontaneously occurring behaviour patterns or postures (e.g. how pain alters normal behaviours such as feeding or social interaction, produces novel ‘pain-specific’ behaviours, or alters facial expression) to behavioural tests which aim to assess the motivational significance of pain.

Research assessments of pain also commonly include assessment of physiology. This might involve assessment of the stress response systems of the body (see Unit 12 on ‘Freedom from Fear and Distress’ for more details). In some cases research has also investigated neurophysiological variables in order to make inference about pain.

10.4.2 Assessing Pain under Clinical Conditions

In contrast to research studies, pain assessment methods applied in clinical contexts (for instance in a veterinary clinic, or on a farm), need to be simple, cheap, quick to apply, and to produce an immediate result. Often clinical assessments made simply involve a subjective judgement applied by the relevant care-taker (e.g. veterinarian, farmer or owner). Such judgements are often highly variable as they can be affected by personal characteristics of the observer such as prior experience, attitudes to animals, and knowledge levels.

10.4.3 Assessing Pain using Rating Scales

A more numerical approach can be applied through the use of rating scales. These approaches vary from the simple to the more complex, but all have the inherent aim that the pain state of the animal is assessed by an observer against some prior criteria, and that this assessment results in a classification (most often numerical) of pain which can be used to guide treatment or to monitor change over time. The simplest possible rating scale is a Visual Analogue Scale, where
an observer simply rates the pain experienced by the animal by marking a position upon a single line, which ranges from “No Pain” at one end to “Worst possible pain” at the other end. The measured distance along the line is used as the pain rating. More complex approaches such as Simple Descriptive Scales, Numerical Rating Scales, or Multidimensional Scales ask observers to rate animals according to specific criteria. In the latter, this may also include assessment of physiological variables such as heart rate, respiration rate, body temperature, hypertension etc.

10.4.4 Assessing Sickness Behaviour

The main approach to assessing sickness behaviour involves measuring deviations from normal behaviour. The behavioural profile commonly associated with infection includes:

- Reduced activity (lethargy)
- Increased sleep
- Reduced feed intake (anorexia)
- Reduced social (and sexual) interactions
- Reduced exploration
- Reduced grooming, and
- Increased fearfulness

Assessment of these changes provides a good indication of the severity of disease being experienced by the animal. In addition to the broad sickness response, there may often be specific behavioural signs associated with some disease states. These often occur due to specific localised sources of pain or discomfort, as the animal tries to protect a sensitive body region or alleviate the source of the problem (e.g. by rubbing or scratching).

10.5 Issues Associated with Pain

a) Individual Variability

Pain is a motivational phenomenon that alters behaviours to limit tissue damage, promote recover, and avoid reoccurrence. However, this motivational aspect of pain means its effects on behaviour interact with other priorities. Pain assessment is therefore challenging because pain experiences can vary from transient to dominating and show substantial variability both between individuals and within an individual at different times.

b) Which Animals Feel Pain?

One issue which is still the subject of substantial debate in the scientific literature is the extent to which different species or groups of animals are thought to be capable of experiencing pain. Whilst there is a broad scientific consensus that all mammalian species are capable of pain experiences, it is only in recent decades that attention has turned to other groups such as birds or fish. Studies in these groups have supported the assertion that these animals are also capable of experiencing pain. This has been widely accepted in birds but remains the subject of debate in fish, with some researchers suggesting that fish are incapable of experiencing an aversive emotional state of pain due to their particular brain structures.
Before we proceed, please complete activity 2.

### Activity 2 (Case Study & Visit):

**a) Case Study – Pain Relief through Suppress – Substitute – Soothe**

Pain relief (analgesia) may be provided to animals for many different reasons. It is often felt to be the right thing to do in itself (i.e. due to an ethical perspective). Alternatively, it may be considered the rational thing to do. Pain is inherently an aversive emotional state. However, it is also a normal aspect of biology and has many benefits. Many people would feel that there are circumstances where it is acceptable for animals to feel pain, for instance if that pain is momentary or mild, or if there is a greater benefit to the animal (for instance, the experience of some level of post-surgical pain may be deemed acceptable if that surgery has prevented a greater harm to the animal). In purely rational terms alleviating animal pain may be the correct approach since pain inevitably has a range of side-effects. In farm animals this includes reduced productivity or impaired fertility. Pain may cause stress responses that have negative impacts on other aspects of health; for instance, damaging immune function or delaying wound healing.

To maximize animal welfare in any context, pain should be minimized wherever possible. Researchers in France recently highlighted the three main approaches whereby pain can be minimized in animals; they labelled these the 3Ss:

- **Suppress** – avoid the problem altogether
- **Substitute** – do something less painful
- **Soothe** – provide treatment for pain

One widespread issue in relation to pain and animal welfare is the practice of de-horning calves. De-horning is practiced in order to reduce the risk of injury from horns both to human handlers and other animals. The requirement for de-horning is therefore a specific outcome of humans managing cattle for production reasons and is more or less of an issue depending on the production system used.

Applying the principles of the 3Ss to dehorning we can identify a number of approaches which could minimise the pain associated with the procedure.

1) Firstly, in terms of **Suppressing**, it is often possible to manage cows in such a way that they can live with horns. Indeed, in many countries and production systems this would be the norm. Another approach is the use of polled cattle (i.e. animals that do not have horns, either naturally or as a result of artificial selection).

2) In relation to **Substitution**, animal welfare researchers have investigated alternative approaches to horn removal that reduce the pain experience. This work has shown, for instance, that cautery disbudding is less painful to calves than amputation dehorning.

3) Finally, in terms of **Soothing** the pain, a large research literature addresses the question of how much the pain experience can be limited by
pharmaceutical treatments. In relation to horn removal this work has shown that substantial reductions in pain can be achieved through the use of local anaesthetic pain blocks combined with Non-Steroidal-Anti-Inflammatory Drugs (NSAIDS) which limit pain and inflammation following the procedure.

Recent work in Canada and the UK suggests that farmers and veterinarians are increasingly aware of the benefits of minimizing pain associated with horn removal, and as a consequence the number of animals receiving these treatments is increasing.

b) **Visit:** Visit a nearby dairy farm and discuss with farm manager about applying the principles of the 3Ss Suppress – Substitute –Soothe to dehorning or in any other management practice. Write your remarks on pain relief.

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**Check Your Progress 2**

**Note:** a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) Why might researchers be interested in studying pain?

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2) What is behavioural assessment of pain?

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3) How can pain be assessed using a Visual Analogue Scale?

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4) How can sickness behaviour be assessed?

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5) Why is pain assessment challenging?

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10.6 LET US SUM UP

- Assessment of factors relating to the Five Freedoms has been central to animal welfare research and has resulted in many improvements in the lives of animals under human care.

- Through assessment of animal behaviour and physiology inferences can be made about subjective emotional states such as pain, sickness, fear, or distress. Assessment methods may vary between controlled experimental settings, where fundamental research into animal welfare is conducted, and practical ‘real-life’ settings.

- In many instances, animals experience complex combinations of these different emotional states and often assessing the fulfilment of one freedom requires reference to another. For instance, examining questions about restrictions on behaviour often involves assessments of the consequences for distress, fear or pain.

- Whilst the Five Freedoms may represent an unobtainable ideal state of welfare they continue to have value within animal welfare research and practice.

10.7 KEYWORDS

Analgesia: Absence of pain in response to stimulation which would normally be painful.

Aversive: A property of a stimulus or situation that is unpleasant and provokes avoidance.
Displacement activity: A behavioural seen in an unusual context often as a result of conflict between different motivational states, or frustration at being unable to fulfill a strong motivational urge.

Emotion: A strong conscious experience, which can be positive or negative.

10.8 BIBLIOGRAPHY AND FURTHER READING


Web resources

Information on laboratory rodent handling: https://www.nc3rs.org.uk/handling-and-restraint

Information on alternatives to farrowing crates: https://www.freefarrowing.org

10.9 SELF ASSESSMENT EXERCISES

1) Classify pain according to location, type, and timing. Explain with suitable examples.

2) Discuss various approaches to pain assessment in animals.

3) Pick a known painful condition for animals and identify how the pain might be minimized with references to the 3S approach.

10.10 ANSWERS / HINTS TO CHECK YOUR PROGRESS

Check Your Progress 1

1) The International Association for the Study of Pain (IASP) defines pain as: “an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage”.

2) Nociception is the process whereby actual or potential tissue damage is detected (by specialist nerve cells, known as *nociceptors*) and signaled to the brain via the spinal cord. The brain then processes these signals, along with other information about bodily state, and produces the conscious aversive experience of pain.

3) Somatic pain is associated with damage to the skin, muscle, bones or other soft tissues of the body. Whereas visceral pain is associated with damage to the internal organs of the body.
4) Following on from immediate acute pain is a stage of sub-acute or secondary pain associated with injury; for instance as a result of an inflammatory state caused by tissue damage.

5) Injury and disease are two major sources of pain.

6) Tail-docking, castration, de-horning or de-beaking etc are intentional injuries caused by humans as part of management.

7) Sickness behaviour is not simply a consequence of debility, where the animal is incapable of performing other behaviours, rather it should be considered an adaptive, organised, motivational state that conserves energy, avoids danger, promotes recovery, or avoids further disease transmission.

Check Your Progress 2

1) Within veterinary research or animal welfare, researchers may be interested in studying pain to: assess the painfulness of an injury or disease associated with a production system; compare the overall painfulness of different treatments; examine the impact of pain relief methods; Assess the painfulness of an injury or disease associated with a production system; compare the overall painfulness of different treatments, and; examine the impact of pain relief methods.

2) Behavioural assessments of pain may range from simple responses / reflexes to sensory stimulation, through to assessment of more complex spontaneously occurring behaviour patterns or postures (e.g. how pain alters normal behaviours such as feeding or social interaction, facial expression) to behavioural tests which aim to assess the motivational significance of pain.

3) By using Visual Analogue Scale, an observer simply rates the pain experienced by the animal by marking a position upon a single line which ranges from “No Pain” at one end to “Worst possible pain” at the other end. The measured distance along the line is used as the pain rating.

4) The main approach to assessing sickness behaviour involves measuring deviations from normal behaviour. They includes: reduced activity (lethargy); increased sleep; reduced feed intake (anorexia); reduced social (and sexual) interactions; reduced exploration; reduced grooming, and; increased fearfulness.

5) Pain assessment is challenging because pain experiences can vary from transient to dominating and show substantial variability both between individuals and within an individual at different times.
UNIT 11  FREEDOM TO EXPRESS NORMAL BEHAVIOUR

Structure
11.1 Learning Outcomes
11.2 Introduction
11.3 Normal Behaviour
  11.3.1 Concepts and Definitions
  11.3.2 What is Normal Behaviour?
11.4 Assessment of Normal Behaviour
11.5 Issues in Normal Behaviour
  11.5.1 Not all Normal Behaviours are Good
11.6 Let Us Sum Up
11.7 Keywords
11.8 Bibliography and Further Reading
11.9 Self Assessment Exercises
11.10 Answers / Hints to Check Your Progress

11.1 LEARNING OUTCOMES

a) Knowledge and Understanding: After studying this Unit you will be able to:
   - Understand the concept and definitions of normal behaviour.
   - Outline the main ways that normal behaviour can be assessed and provide examples of how animal welfare has been improved by consideration of normal behaviour assessment methods.

b) Practical and Professional Skills: After studying this Unit you will be able to:
   - Discuss how abnormal behaviour is linked to animal welfare with scientific rationality.

11.2 INTRODUCTION

Dear Learner,

In Units 8-10, we discussed the first three Freedoms, and the means to achieve them as follows:

- Freedom from hunger, thirst and malnutrition - by ready access to water and a diet to maintain full health and vigour.
- Freedom from discomfort – by providing an appropriate environment.
- Freedom from pain, injury and disease – by prevention or rapid diagnosis.

In this Unit, we will consider the fourth of the Five Freedoms i.e Freedom to express normal behaviour – by providing space, facilities and company of species
own kind. In the following sections, definitions of each of these states will be provided and discussed. Major issues involved in normal and abnormal behaviour are reviewed along with the most appropriate methods for assessing these states. A case study is provided to illustrate how a scientific understanding of the underlying problem has led to a solution.

11.3 NORMAL BEHAVIOUR

11.3.1 Concepts and Definitions

As noted in Unit 7, the modern understanding of ‘Freedom to Express Normal Behaviour’ is that animals should be able to perform:

- Normal behaviours for its species
- Normal standing and lying movements
- Normal social behaviours, play, grooming, and
- Any species specific responses.

The concept that natural behaviour is important and that restriction of its performance causes suffering goes back to the early days of interest in animal welfare. A key point of debate has been whether good animal welfare can be achieved by providing animals with all their basic requirements (e.g. acceptable environmental parameters, nutrition) or whether, in addition to achieving these, animals need to be able to perform some or all aspects of their possible behavioural repertoire. Some might claim (e.g. under a naturalness view of animal welfare) that an inability to perform all normal behaviours, by definition compromises welfare. However, a more mainstream view would be that it needs to be experimentally established whether particular behavioural restrictions impair welfare.

This freedom is the only one of the five that represents a freedom “to” rather than a freedom “from”. This distinction makes this freedom more ambiguous than the others since it does not demand that a specific negative state is avoided, and therefore the fulfillment of this freedom can be more controversial and open to debate. Despite such limitations, this freedom does capture important aspects of welfare missing from the others; for instance, that satisfying this freedom can actively lead to experiences of positive welfare, rather than simply the avoidance of welfare impairments.

11.3.2 What is Normal Behaviour?

Animal welfare researcher Marek Špinka defines natural behaviour as

“those behavioural elements and their sequences that are adaptive, i.e. that have evolved either during the evolution of the species or during its domestication “in order” to increase the fitness...of the behaving animal”

This definition highlights that an important first step in assessing the role of ‘normal’ behaviour in animal welfare is to compare behaviour of captive animals with wild conspecifics, or – for domesticated species – with related / ancestral species in the wild (where this is possible). However, even where such comparisons are possible it is too simplistic to presume that deficits in captive
animal behaviour imply a welfare problem. Wild animals are flexible in their behaviour, meaning that different behaviours or time budgets may be seen when species live in different habitats, and within a species individual animals may achieve the same functional results via different behavioural routes. To further investigate this issue requires some further understanding of the behaviour in question; this would include establishing the function of the behaviour and the nature of its control.

Example: The relative importance of internal and external factors in driving the behaviour.

Some behaviours may not be required if the animal is provided with a relevant resource.

Example: Animals probably do not need to perform search behaviour for water to drink if they have a suitable provision of water in their home pen.

The key is in identifying behaviours where motivational importance to the animal is high, even when the end product of the behaviour is satisfied— as opposed to stimulus-driven behaviours where in the absence of the stimulus no motivated drive to perform the behaviour is experienced.

Example: Wallowing behaviour in pigs is only seen above certain temperature thresholds— so not providing conditions that allow wallowing is only a problem if those thresholds are regularly exceeded.

Broadly speaking, there are three important aspects of housing or husbandry relating to normal behaviours:

- Space
- Resources, and
- Social composition.

Let us discuss them briefly:

1) **Space**

For many animals, particularly those kept under intensive farming conditions, a significant limiting factor on the display of natural behaviour can be space. However, limited space can be an issue for laboratory, companion and wild captive animals too. Indeed, issues relating to natural behaviour may be most acutely felt where human intervention has resulted in wild animals being maintained in captivity, e.g. as part of a Zoological collection.

2) **Resources**

In addition to basic requirements for space, animals often require specific resources to fulfill particular behaviours.

Examples: In animal welfare science examples include the use of a water bath by farmed mink or access to substrates that allow dustbathing behaviours in poultry.

More generally it is widely appreciated in animal welfare that many animals also need opportunities for exploration or environmental interaction. The absence of this can lead to abnormal behaviours and other welfare problems.
Five Freedoms

3) **Social Environment**

Perhaps one of the most critical aspects of provision in the captive environment is providing an animal with an appropriate social environment. Yet, in many situations for farm, companion, laboratory or wild/zoo animals the social environment may be highly inappropriate.

*Example:* Isolation from other animals or frequent alteration of group composition.

These contexts may therefore limit the performance of normal social behaviours – for instance, in general terms for isolated animals, or in specific terms when limitations on normal reproductive or maternal behaviours are imposed.

Before we proceed, please complete activity 1.

**Activity 1 (Visit & Discussion):** Visit a nearby Zoo and discuss with the authorities about Space, Resources, and Social composition aspects of housing or husbandry relating to normal behaviours and associated animal welfare issues. Compare them with the discussion in the above section and write your observations.

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**Check Your Progress 1**

**Note:**

a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) Write the normal behavioural functions that animals should be able to perform under ‘Freedom to Express Normal Behaviour’

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2) Why is ‘Freedom to Express Normal Behaviour’ ambiguous, more controversial and open to debate than the other Freedoms?

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3) Define natural behaviour

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4) What are the three important broad aspects of housing or husbandry relating to normal behaviour?

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11.4 ASSESSMENT OF NORMAL BEHAVIOUR

The assessment of animal welfare in relation to performance of normal behaviour has mostly focused on two main approaches:

1) Assessing the consequences of not being able to perform a specific behaviour.

2) Experimentally quantifying the motivational important of access to conditions which allow the performance of behaviour.

Under conditions where a behaviour cannot be performed (for instance, if it requires a particular environmental resource) animals may show no alteration to their behaviour or physiology, suggesting that the absence of the behaviour from their repertoire is trivial. Alternatively, such conditions may cause clear and substantial alterations to behaviour and physiology. Changes to behaviour can include signs of frustration or re-directed attempts to perform the behaviour (for example when piglets ‘belly-nose’ other piglets as a re-directed form of the normal behaviour they would perform on the sow to stimulate milk let-down). Abnormal behavioural responses can also include things like stereotypy or displacement activities.

A complementary approach to such assessments is the use of various behavioural choice / preference / motivational test paradigms that allow animals to behaviourally report on the strength of their preferences, or the strength of their motivational drive to perform a specific behaviour. Various such approaches exist but the common element is that experimental set-ups are used that ask the animal to report on how important behaviours are to them e.g. where animals pay a ‘cost’ to access the conditions (e.g. simply more space, or specific resources).
where the behaviour can be performed, e.g. by walking a long distance, pushing a heavy door, or by forgoing some other important resource.

### 11.5 ISSUES IN NORMAL BEHAVIOUR

#### 11.5.1 Not all Normal Behaviours are Good

If taken literally this freedom would imply that animals should be able to perform all behaviours in their repertoire. However, as we have seen, individual behaviours appear to have varying importance to animals. In addition, there are two categories of normal behaviour that actively contribute to, or indicate, a welfare problem:

- The first of these can be called ‘emergency’ behaviours as outlined by Marek Spinka; these include behavioural reactions to challenge such as fear or pain responses. The performance of such behaviours is considered bad for animal welfare.
- The second category is behaviours that improve the life status (welfare) of the actor at the expense of the recipient.

The most obvious of these is aggression between conspecifics. Aggressive behaviours are normal for many species and are seen in the wild. However, this normal behaviour can be seen to occur at abnormal levels in some captive conditions, and whilst the welfare of animals that win aggressive encounters could be debated, there are unambiguous costs to welfare for animals that lose.

Before we proceed, please complete activity 2.

**Activity 2 (Case Study & Visit):**

**a) Case Study on Restriction to Normal Behaviour – Nest Building Prior to Giving Birth (Farrowing) in Pigs:** One good example of a restriction to normal behaviour which harms animal welfare is the case of nest-building prior to giving birth (Farrowing) in pigs. In the ancestral species, the Wild Boar, pregnant females are seen to perform nest building prior to farrowing. After detaching herself from her social group the sow gathers foliage from the surrounding environment and forms an enclosed nest within which she will give birth. For much of the domesticated history of the pig, sows were able to perform a rudimentary version of this nest building. However, in the latter half of the 20th century a new system for sow farrowing housing was developed: the farrowing crate, which is used to boost pig production by minimizing piglet mortality (e.g. from crushing by the sow) (Fig. 11.1).

![Fig. 11.1: Farrowing Crate](https://infograph.venngage.com/p/188613/sow-farrowing-crates)
Farrowing crates greatly limit sow movements; sows are able to stand up and lie down but are not able to turn around, and have only limited forward and backward movement. This represents a space restriction, but also – during the period prior to birth – the highly restricted ability to perform even basic nest-building behaviours. Sows in crate will still attempt to perform nest-building behaviours, even in the absence of any substrate. In terms of behavioural control, nest building occurs in response to physiological changes in the sow, occurring at predictable times prior to birth, yet under wild conditions nest-building is variable and responses to environmental conditions (e.g. less effort made if aspects of natural terrain provide shelter) i.e. it is internally driven but shaped by the environment. Numerous studies have demonstrated that the restricted ability of sows to nest-build causes signs of behavioural distress and increased levels of various stress hormones.

The fuller understanding of the impact that this restriction has on sow welfare has led to increased interest in developing alternative systems, which do not restrict the sow’s behaviour but which achieve acceptable levels of piglet mortality. Such work has led some countries – e.g. Norway, Sweden and Switzerland – to ban farrowing crates entirely, and within other countries has led retailers or farm assurance schemes to adopt ‘free’ farrowing alternatives to the crate.

b) Visit: Visit a nearby Pig Farm and discuss with farm manager about the utility of farrowing crates. Compare his / her view points with what you read in the above case study and write your remarks on the following:

i) How are farrowing crates restricting the normal behaviour of a sow?
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ii) Positive and negative aspects of farrowing crates on Sow welfare.
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iii) Positive and negative aspects of farrowing crates on Piglet welfare.
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Check Your Progress 2

Note: a) Use the spaces given below for your answers.
    b) Check your answer with those given at the end of the unit.

1) What are the two main behavioural approaches to assessing the effect of
   behavioural restriction on animal welfare?
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2) What are ‘emergency’ behaviours?
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3) How do farrowing crates boost pig production?
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11.6 LET US SUM UP

- The fourth of the Five Freedoms is freedom to express normal behaviour –
  by providing space, facilities and company of species own kind.

- In freedom to express normal behaviour; animals should be able to perform:
  Normal behaviours of its species; Normal standing and lying movements;
  Normal social behaviours, play, grooming, and; Any species specific
  responses.

- A key point of debate has been whether good animal welfare can be achieved
  by providing animals with all their basic requirements (e.g. acceptable
  environmental parameters, nutrition) or whether, in addition to achieving
  these, animals need to be able to perform some or all aspects of their possible
  behavioural repertoire.

- This freedom is the only one of the five that represents a freedom “to”
  rather than a freedom “from”. This distinction makes this freedom more
  ambiguous than the others since it does not demand that a specific negative
  state is avoided, and therefore the fulfilment of this freedom can be more
  controversial and open to debate.
An important first step in assessing the role of ‘normal’ behaviour in animal welfare is to compare behaviour of captive animals with wild conspecifics, or – for domesticated species – with related / ancestral species in the wild (where this is possible).

The three broad aspects of housing or husbandry relating to normal behaviours are: space; resources; and social composition.

The assessment of animal welfare in relation to performance of normal behaviour has mostly focused on two main approaches: assessing the consequences of not being able to perform a specific behaviour, and experimentally quantifying the motivational important of access to conditions which allow the performance of behaviour.

Emergency behaviours include behavioural reactions to challenge such as fear or pain responses. The performance of such behaviours is considered bad for animal welfare.

### 11.7 KEYWORDS

**Abnormal Behaviour:** Behaviour that either are not shown in the wild at all or at a different level to that in captivity and cause problems for humans, the animal or other group members.

**Animal Behaviour:** Refers to the physical expression of bodily movements that result from an internal drive or motivation.

**Farrowing:** It is a term specific to Pig that refers to the action of giving birth.

**Natural Behaviour:** This encompasses those behaviours shown by the species under wild conditions and at the same frequency, duration or intensity. It does not include those behaviours that are shown only in captivity but not seen in the wild or those shown at a level that differs from the wild.

**Redirected Behaviour:** Targeting of behaviour towards a group member due to the absence of a more appropriate target.

**Stereotypical Behaviour:** Repetitive, apparently functionless sequences of behaviour.

**Stimulus-driven Behaviour:** A behaviour that occurs as a result of a specific event or cue external to the animal.

**Subjective Mental State:** A conscious experience, which is only accessible to the individual experiencing it.

### 11.8 BIBLIOGRAPHY AND FURTHER READING


Web resources

Information on laboratory rodent handling: https://www.nc3rs.org.uk/handling-and-restraint

Information on alternatives to farrowing crates:https://www.freefarrowing.org
11.9 SELF ASSESSMENT EXERCISES

1) Discuss the advantages and limitations of comparing behaviour of captive animals with wild conspecifics in assessing the role of ‘normal’ behaviour in animal welfare.

2) What is the role of space, resources, and social composition aspects of housing or husbandry relating to normal behaviour?

3) Discuss the two main approaches of assessing animal welfare in relation to performance of normal behaviour.

4) Not all normal behaviours are good. Comment

11.10 ANSWERS/HINTS TO CHECK YOUR PROGRESS

Check Your Progress 1

1) The normal behavioural functions under this freedom includes: normal behaviours of its species; normal standing and lying movements; normal social behaviours, play, grooming, and; any species specific responses.

2) This freedom is the only one of the five that represents a freedom “to” rather than a freedom “from”. This distinction makes this freedom more ambiguous than the others since it does not demand that a specific negative state is avoided, and therefore the fulfillment of this freedom can be more controversial and open to debate.

3) Those behavioural elements and their sequences that are adaptive, i.e. that have evolved either during the evolution of the species or during its domestication “in order” to increase the fitness of the behaving animal.

4) The three important broad aspects of housing or husbandry relating to normal behaviour are: space; resources, and social composition.

Check Your Progress 2

1) The two main approaches are: Assessing the consequences of not being able to perform a specific behaviour, and ; Experimentally quantifying the motivational important of access to conditions which allow the performance of behaviour.

2) Emergency behaviours include behavioural reactions to challenge such as fear or pain responses. The performance of such behaviours is considered bad for animal welfare.

3) Farrowing crate system is used in sow housing to boost pig production by minimizing piglet mortality (e.g. from crushing by the sow).
UNIT 12 FREEDOM FROM FEAR AND DISTRESS

Structure
12.1 Learning Outcomes
12.2 Introduction
12.3 Fear and Distress
   12.3.1 Concepts and Definitions
12.4 Assessment of Fear and Distress
   12.4.1 Behavioural Tests of Fear
   12.4.2 Physiological Assessments of Fear / Distress
   12.4.3 Issues (Individual Variability)
12.5 Let Us Sum Up
12.6 Keywords
12.7 Bibliography and Further Reading
12.8 Self Assessment Exercises
12.9 Answers / Hints to Check Your Progress

12.1 LEARNING OUTCOMES

a) Knowledge and Understanding: After studying this Unit you will be able to:
   - Understand the definitions of fear and distress.
   - Explain the principles of assessing fear and distress.

b) Practical and Professional Skills: After studying this Unit you will be able to:
   - Discuss how fear and distress affects animal welfare with scientific rationality.

12.2 INTRODUCTION

Dear Learner,

In Units 8-11, we discussed the first four Freedoms, and the means to achieve them as follows:

- Freedom from hunger, thirst and malnutrition - by ready access to water and a diet to maintain full health and vigour.
- Freedom from discomfort – by providing an appropriate environment.
- Freedom from pain, injury and disease – by prevention or rapid diagnosis.
- Freedom to express normal behaviour – by providing space, facilities and company of species own kind.

In this Unit, we will consider the fifth of the Five Freedoms i.e Freedom from fear and distress – by ensuring conditions and treatment to avoid mental suffering.
In the following sections, definitions of each of these states will be provided and discussed. Major issues involved in fear and distress are reviewed along with the most appropriate methods for assessing these states. A case study is provided to illustrate how a scientific understanding of the underlying problem has led to a solution.

12.3 FEAR AND DISTRESS

12.3.1 Concepts and Definitions

As with pain, fear and distress are terms that are routinely applied in everyday life. However, much of the scientific interest in animal welfare studies has focused on how they can be meaningfully applied to animals, and how we might recognize animals that were experiencing such states. Boissy (1995) provided the following definition of fear as an:

“emotional state...induced by the perception of any actual danger...that threatens the well-being of the individual”.

Fear is adaptive for wild animals by preparing the individual for danger. Whilst domestication has often reduced fear responding (particularly to humans), domesticated animals still show fear responses. Various aspects of the captive environment can provoke fear in animals, including: isolation, separation of closely bonded animals (e.g. mothers and offspring), negative social interactions, restraint, negative human handling, painful experiences or disease.

The concept of animal stress is central to animal welfare science. The term stress is widely used yet often poorly defined. Hans Selye, considered by many as the father of modern stress research, said: “everybody knows what stress is and nobody knows what it is”. Although there has been no clear consensus on a definition, stress is generally seen as the result of a challenge to an individual’s homeostasis. It is important to distinguish between the stimulus (the stressor) that is perceived as a threat, the stress state of the animal and the resulting stress response. In this schema, the stress state is viewed as involving a negative mental experience (the perception of stress, sometimes called distress), which is not observable and can only be experienced by the individual. In welfare research the aim is to measure aspects of the stress response as a correlate of the distress state.

12.4 ASSESSMENT OF FEAR AND DISTRESS

Fear in animals is assessed for two main reasons:

i) Animal models for basic science and translation

ii) Animal welfare assessment

As with other emotional states, fear can be considered to have three components:

i) Behavioural

ii) Autonomic, and

iii) Actual subjective experience (the feeling).

In the absence of verbal self-report of the subjective experience, assessments of animal fear have focused on behavioural and physiological parameters. In the
case of the former, measurements are either made of spontaneous behaviours (under home environment conditions) or in specific behaviours test situations.

Various spontaneous behaviours have been used as indicators of fear in captive animals. These include:

- Vocalisation
- Escape/avoidance behaviour
- Freezing and vigilance.

Let us discuss behavioural tests of fear and physiological assessments of fear / distress briefly

### 12.4.1 Behavioural Tests of Fear

Behavioural tests of fear include:

i) Open field test

ii) Elevated plus maze test

iii) Staged exposure to novelty

iv) Human interaction tests

v) Tonic immobility test

Let us discuss them briefly:

i) **Open Field (OF)**

The OF test was developed for use in rodents and is widely applied in biomedical research. In the OF test, the animal is moved to a novel barren arena. In rodents simple behavioural measures, such as thigmotaxis (a preference to stay near a vertical surface), defecations/urination, or overall activity are measured. In rats it is presumed that animals that show high levels of thigmotaxis (ie by spending more time at the periphery of the OF) are more fearful.

ii) **Elevated Plus Maze (EPM)**

As with the OF, the EPM was developed as a test of fear/anxiety in rats and mice. The classic EPM apparatus involves two enclosed arms and two open (without walls) arms, arranged in a + shape and elevated off the ground (Fig. 12.1). More fearful animals spend less time in the open arms. This test

![Elevated Plus Maze Test](https://eurekalert.org/multimedia/pub/205684.php)
uses a mouse’s natural preference to stay in dark and narrow places (closed arms). The longer a mouse spends in the open areas (open arms) and the more distance it travels, the more its anxiety level is thought to decrease (as shown in Figure 12.1).

iii) Exposure to Novelty

Exposure to novelty is used widely as a test of fear – most commonly in relation to exposure to a Novel Object (NO) test. In animal welfare research, NO tests are common and the behavioural reaction to novelty may be assessed either in an unfamiliar environment or in the animal’s home environment. Behavioural measures commonly used in relation to the NO test include:

- Approach behaviour
- Latency to contact the object, and
- Duration of contact / exploration with the object.

A long latency to first contact or limited interaction with a Novel Object may be taken as an indication of fear.

iv) Human Interaction Tests

Various forms of human interaction test have been used in animal welfare research. The general principle is that behaviours (or sometimes physiological) responses of an animal to a human being are assessed, for instance, how willing the animal is to approach the person. Approach tests are one type of assessment that have been used under real-life conditions, such as on farms.

v) Tonic Immobility (TI) Test

A complete behavioural inhibition following a brief restraint is seen in a phylogenetically wide range of species. Such inhibition is commonly referred to as tonic immobility. The tonic immobility response involves muscle relaxation causing motor inhibition, altered brain activity, increased heart rate and a lack of responses to external stimuli. These responses are thought to be part of the animal’s anti-predator defenses and the duration that an animal remains immobile is presumed to be positively related to its underlying fearfulness. The TI test has been used widely in studies of poultry welfare.

12.4.2 Physiological Assessments of Fear / Distress

Measurement of physiological variables has contributed to a greater understanding of fear/distress. This either involves assessment of immediate acute reactions, which serve to prepare the animal for action (flight or fight), or longer-term consequences. Most commonly such assessment would involve measurements of aspects of the hypothalamo-pituitary-adrenal (HPA) or sympathetic-adrenal-medullary (SAM) axes. These two systems represent the primary stress response systems of the body and physiological outputs from them, such as glucocorticoids (cortisol or corticosterone depending on the species) for the HPA axis, or catecholamines (such as adrenaline) for the SAM, are often measured to assess how distressing an animal finds an environmental challenge. Functional
downstream consequences of stress system activation, such as increased heart or respiration rate, may also be assessed.

12.4.3 Issues (Individual Variability)

In all animals fear motivated behaviours (and the physiological response that co-occur) must be balanced and appropriate. Too much fearfulness can be counterproductive (fear response are costly in time and energy), and as a consequence fear responses are plastic, or changeable, to some degree. As with other facets of animal welfare, one important aspect of assessing fear or distress is the substantial individual variability that exists between animals. Even under very similar husbandry and management circumstances, individuals may differ substantially in how fearful they are as a consequence of their genetic composition (fear response are heritable and can be selected upon), early life experience (before birth or in the early neonatal period) or other events throughout their lifetime.

Before we proceed, please complete activity 1.

Activity 1 (Case Study & Visit):

a) **Case Study on Assessment of Fear:** Assessments of fear are often used to compare different housing systems or handling treatments for animals. Handling methods become especially important when animals are regularly handled by humans. For instance, in laboratory research, animals may be handled frequently and in a way that fully restrains the animal. Since the animals involved – most often rats and mice – are likely to view humans as potential predators this handling is likely to have a substantial effect on their fear levels. This represents an animal welfare issue and could also negatively affect the quality of the scientific studies being conducted. Jane Hurst at the University of Liverpool has investigated different methods for handling laboratory rodents. Traditionally, laboratory mice have been handled – or instance, to be moved between cages or for experimental measurements or procedures – by being lifted up by their tail. Hurst and her colleagues investigated the use of an alternative approach where mice are moved in a small tunnel – which remains in their home cage at other times. These studies show that mice handled using a handling tunnel, are less anxious / fearful in an EPM than those handled using the traditional approach of lifting by the tail. Mice handled using the tunnel approach was also more willing to approach a human handler. This simple change to standard practice is increasingly being adopted by research laboratories to improve welfare.

b) **Visit:** Visit a nearby research facility with laboratory animals and discuss the above case with the person in-charge. Also observe how they are handling different laboratory animals with associated welfare issues related to fear and distress. Write your remarks:

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Check Your Progress 1

Note:  
a) Use the spaces given below for your answers.  
b) Check your answer with those given at the end of the unit.

1) How can fear be described?
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2) Name any four aspects of the captive environment that provoke fear in animals.
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3) What do you understand by stress / distress state in the context of animal welfare?
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4) Write the three components of fear
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5) What is tonic immobility?
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6) Name different types of behavioural test used to assess fear behaviour.
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7) What do the abbreviations HPA and SAM stand for?
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12.5 LET US SUM UP
- In this Unit, we discussed the fifth of the Five Freedoms i.e Freedom from fear and distress – by ensuring conditions and treatment to avoid mental suffering.
- Definitions of each of these states are discussed and major issues involved in fear and distress are reviewed along with the most appropriate methods for assessing these states.
- Fear in animals is assessed for two main reasons: Animal models for basic science and translation, and; Animal welfare assessment.
- Behavioural tests of fear include: Open field test; Elevated plus maze test; Staged exposure to novelty; Human interaction tests, and; Tonic immobility test.
- Measurement of physiological variables has contributed to a greater understanding of fear/distress. This either involves assessment of immediate acute reactions which serve to prepare the animal for action (flight or fight) or longer-term consequences.
- As with other facets of animal welfare, one important aspect of assessing fear or distress is the substantial individual variability that exists between animals.
- Handling treatments of lab animals and associated fear and welfare assessment is discussed with the help of a case study.

12.6 KEYWORDS
Distress: An extreme anxiety, sorrow, or pain.

Elevated Plus Maze (EPM): The EPM was developed as a test of fear/anxiety in rats and mice.
Fear: An unpleasant emotion caused by the threat of danger, pain, or harm.

Open Field (OF): It is an experimental test used to assay general locomotor activity levels, anxiety, and willingness to explore in animals (usually rodents) in scientific animal welfare research.

Subjective Mental State: A conscious experience, which is only accessible to the individual experiencing it.

Thigmotaxis: This is an index of anxiety in mice and rats - a preference to stay near a vertical surface.

Tonic Immobility: A complete behavioural inhibition following a brief restraint is commonly referred to as tonic immobility.

12.7 BIBLIOGRAPHY AND FURTHER READING


Web resources

Information on laboratory rodent handling: https://www.nc3rs.org.uk/handling-and-restraint

Information on alternatives to farrowing crates: https://www.freefarrowing.org

12.8 SELF ASSESSMENT EXERCISES

1) Suggest some approaches to compare the fearfulness of pigs kept under two different husbandry systems

2) How might you experimentally investigate whether the presence of a human being impairs the welfare of an animal?

3) Discuss behavioural tests of fear and physiological assessments of fear / distress with examples.

12.9 ANSWERS / HINTS TO CHECK YOUR PROGRESS

Check Your Progress 1

1) Fear is emotion state induced by the perception of any actual danger that threatens the well-being of the individual.

2) The aspects of the captive environment that provoke fear in animals includes: isolation; separation of closely bonded animals (e.g. mothers and offspring); negative social interactions; restraint etc.

3) The stress state is viewed as involving a negative mental experience (the perception of stress, sometimes called distress), which is not observable
and can only be experienced by the individual. In animal welfare research the aim is to measure aspects of the stress response as a correlate of the distress state.

4) The three components of fear includes: behavioural; autonomic, and actual subjective experience (the feeling).

5) A complete behavioural inhibition following a brief restraint is seen in a phylogenetically wide range of species. Such inhibition is commonly referred to as tonic immobility.


7) HPA: Hypothalamo-Pituitary-Adrenal; SAM: Sympathetic-Adrenal-Medullary