

# TOPIC NOTES FOR BIOL2722: DISEASE & IMMUNOLOGY

Completed in 2017 with Distinction

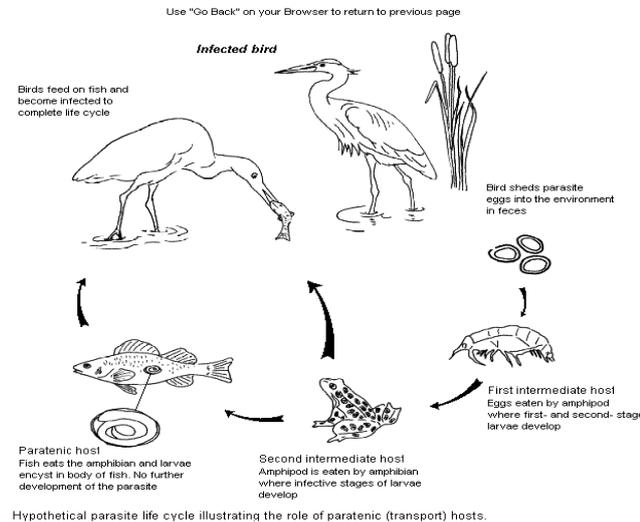
# Contents

WK1: Topic Overview – (Associate Professor James Harris).....	2
WK1: Stress, disease and the environment – (Associate Professor James Harris) .....	3
WK1: Biochemical stress indicators (Primary and secondary stress responses) – (Associate Professor James Harris) ...	4
WK2: Animal Welfare – (Associate Professor James Harris) .....	<b>Error! Bookmark not defined.</b>
WK2: Environmental Stressors – (Associate Professor James Harris) .....	<b>Error! Bookmark not defined.</b>
WK2: Anthropogenic Stressors – (Associate Professor James Harris) .....	<b>Error! Bookmark not defined.</b>
WK3: Nutritional Diseases – (Associate Professor James Harris) .....	<b>Error! Bookmark not defined.</b>
WK3: Infectious Diseases – Koch’s Postulates – (Melissa Brown) .....	<b>Error! Bookmark not defined.</b>
WK4: Infectious Diseases – Bacteria – (Melissa Brown) .....	<b>Error! Bookmark not defined.</b>
WK4: Pathogenicity and Virulence of aquatic diseases – (Shane Roberts) .....	<b>Error! Bookmark not defined.</b>
WK4: Antibiotics: Action and Resistance – (Melissa Brown) .....	<b>Error! Bookmark not defined.</b>
WK5: Fungal pathogens of animals – (Miss Sally Fryar) .....	<b>Error! Bookmark not defined.</b>
WK5: Fungal Pathogens of humans – Miss Sally Fryar) .....	<b>Error! Bookmark not defined.</b>
WK5: Virology Introduction – (Associate Professor Peter Speck).....	<b>Error! Bookmark not defined.</b>
WK6: Human Diseases caused by Viruses – (Associate Professor Peter Speck).....	<b>Error! Bookmark not defined.</b>
WK6: Terrestrial Parasites – (Jody O’Conner).....	<b>Error! Bookmark not defined.</b>
WK6: Invasive Parasites: impacts on wildlife – (Jody O’Conner) .....	<b>Error! Bookmark not defined.</b>
WK7: Evolution of Immunity – (Associate Professor James Harris).....	<b>Error! Bookmark not defined.</b>
WK7: Innate Immunity: the first-line defences – (Associate Professor James Harris) .....	<b>Error! Bookmark not defined.</b>
WK7: Acquired (or adaptive) Immunity – (Associate Professor James Harris).....	<b>Error! Bookmark not defined.</b>
WK8: Monitoring Immunity - (Associate Professor James Harris).....	<b>Error! Bookmark not defined.</b>
WK8: Normal Histology – (Associate Professor James Harris).....	<b>Error! Bookmark not defined.</b>
WK9: Disease diagnosis – (Associate Professor James Harris) .....	<b>Error! Bookmark not defined.</b>
WK9: Notifiable disease and biosecurity- (Marty Deveney).....	<b>Error! Bookmark not defined.</b>
WK10: Non-infectious diseases – genetics, development and neoplasia – (Associate Professor James Harris) .....	<b>Error! Bookmark not defined.</b>
<b>WK11: An introduction to surveillance, monitoring and disease investigation 1 – (Associate Professor James Harris) .....</b>	<b>Error! Bookmark not defined.</b>
<b>WK11: An introduction to surveillance, monitoring and disease investigation 2 – (Associate Professor James Harris) .....</b>	<b>Error! Bookmark not defined.</b>
<b>WK11: Intervention in Viral Infections– (Associate Professor Peter Speck).....</b>	<b>Error! Bookmark not defined.</b>

# WK1: Topic Overview – (Associate Professor James Harris)

## Definitions:

- **Etiology:** the science that assess the causes of diseases.
- **Disease:** an injury/damage that is inflicted to a host that impairs its normal function.
- **Epizootic:** a disease that attacks a large number of animals simultaneously. If this is comprised of one species it is considered as epidemic.
- **Mortality:** death rate.
- **Morbidity:** animals displaying clinical signs of disease.
- **Pathology:** the science concerned with the study of disease including the nature and cause, as well as structural and functional changes resulting from the disease process.
- **Diagnosis:** determination of the nature of a case of disease.
- **Histology:** the microscopic study of the structure of tissues.
- **Lesion:** a pathologic change in the tissue
- **Necrotic:** dead tissue
- **Host:** the organisms in which another organism (pathogen or parasite) grows and derives nourishment.
- **Infectious:** a disease that can be communicated by contact with a pathogen.
- **Infection:** invasion and multiplication of pathogens within a host's body tissue.
  - **Primary infection:** the infectious agent that invades tissues
  - **Secondary infection:** an infectious agent that invades the tissues after another agent has initially damaged the tissue.
- **Infestation:** subsistence on the surface of the skin or gills, without invasion into the tissues. (external parasite)
- **Pathogenicity:** the ability of a pathogen to invade and inflict damage on a host
  - **Toxigenicity:** pathogenicity caused by toxins
  - **Virulence:** degree of pathogenicity
- **Opportunistic:** an organism capable of causing diseases only when the host's resistance is lowered. This may refer to an organism that doesn't normally cause a disease unless the conditions are appropriate.
- **Immunity:** recognition and disposal of foreign material that enters the body. This process confers resistance to the disease.
- **Serum:** fluid portion of animal blood obtained after removing the blood cells
- **Resistance:** the ability of an infectious agent to withstand the actions of the host's immune system or a chemotherapeutic agent.



## Types of disease:

### Non-infectious

- ❖ Genetic
- ❖ **Neoplasia** (cancerous)
- ❖ Nutritional
- ❖ environmental

### Infectious

- ❖ **pathogens**
- ❖ viruses
- ❖ bacteria
- ❖ fungi

### ❖ parasites

### Prevention

- breeding programs
- remove carcinogens/breeding
- balanced diet
- identify and remove stressors
  
- hygiene
- biosecurity measures to prevent transmission

- reduce stress/improve environment
- immunostimulants/ vaccines
- (chemotherapeutics = treatment)

When comparing the exposure of pathogens in terrestrial and aquatic environments, their abundance is much higher in the aquatic environment. This is because organisms are constantly surrounded by, swallowing and ingesting pathogens. There is also biofouling of all surfaces of animals and the environment. In terrestrial environments air is relatively sterile with a microbial refuge in the soil. Subsequently, pathogens may be transmitted via aerosols, faeces and sexual (direct or indirect contact).

## WK1: Stress, disease and the environment – (Associate Professor James Harris)

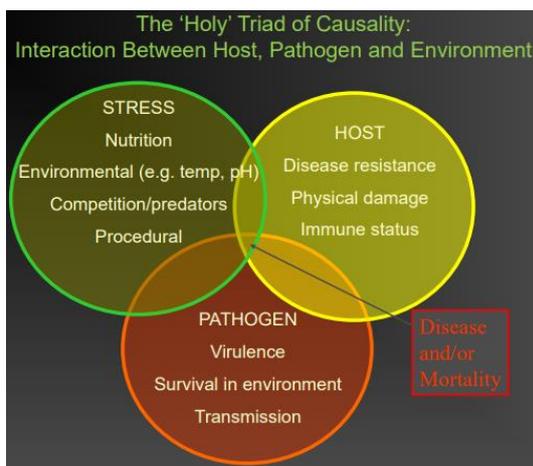
Stress is a state that can lead to a disease occurring. It can be direct such as acute stress which may cause loss of homeostasis, hearty attack and intracellular acidosis or it can be chronic stress such as nutritional deficiency and toxins. Alternatively stress can lead to indirect diseases occurring via infectious pathogens.



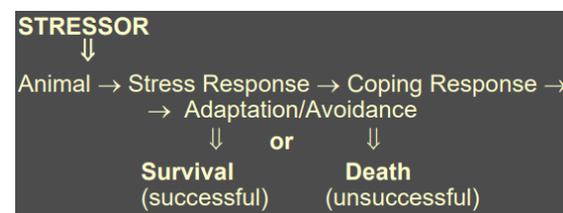
**Stress:** this refers to the altered state of an organism which has been the result of deleterious factors which overtax an individual's control systems and reduces its fitness.

**Stressor:** this refers to a stimulus which is something that is producing a noxious or threatening situation.

**Stress response:** refers to the physiological or behavioural manifestations of a stressed state. This can be an adaptive response that produces the best chance of survival. This have evolved to be advantageous and allow the organism to cope with the conditions.



In the case of prolonged and/or extreme stressors, the stress response may be deleterious to the organism which may result in reduced growth, health, reproduction or simply death. This is because a stress response directs energy away from immediately non-essential processes to more essential processes related to coping responses which may reduce metabolism or activity.



This is because animals tend to maintain homeostasis (a constant internal state). However, this must be altered in order to avoid negative impacts from the diseases with change brought about via behaviour or physiological mechanisms.

Stages in stress response:

1. **Alarm reaction:** this is the initial response to the stimulus which can see a change at the neuroendocrine and endocrine level.
2. **Resistance = coping:** the organism may adjust or compensates to regain homeostasis due to the changed conditions. This may be physiological, biochemical or immunological.
3. **Whole animal responses = adaptive:** this can be in the form of behavioural changes.
4. **Exhaustion:** if unable to cope the organisms may become exhausted leading to the development of a pathological condition, reproductive and/or physical death.
  - **Primary stress response:** neuronal
  - **Secondary stress response:** physiological/biochemical
  - **Tertiary:** whole animal response
  - **Quaternary:** death or long-term fitness consequences

A stressed animal may become nervous, lose its ability/will to feed or may lose control over buoyancy/balance. Should the stress be severe or persistent then exhaustion may ensue causing its natural defences to become overwhelmed. This can see a lowering of resistance to disease.

- Stress negatively affects growth via metabolic processes (anabolism/catabolism) or growth hormone levels.
- Stress negatively impacts reproduction by altering the levels of reproductive hormones, gamete development (delayed) gamete quality (smaller eggs, lower sperm count) and survival/development. Hormonal effects of stress include gonadotropin, gonadal steroids and rapidly decreased sex steroid levels.

Sudden death by acute stress can generally be explained by its timing:

2-6 hours of stressor

- ❖ Ion imbalance (loss of ions)

4-12 hours of exercise stressor causes intracellular acidosis

- ❖ Acidosis (respiratory): the build-up of carbonic acid from CO<sub>2</sub> accumulation.
- ❖ Acidosis (metabolic): the build-up of anaerobic by-products of metabolic activity (e.g. lactic acid)

## WK1: Biochemical stress indicators (Primary and secondary stress responses) – (Associate Professor James Harris)

There are a variety of means to measure stress with each option possesses various degrees of difficulty:

- ❖ Primary: neuroendocrine and endocrine responses
- ❖ Secondary: behavioural, biochemical, physiological and immunological outcomes
- ❖ Tertiary: behavioural, growth rate, immunocompetency, reproductive functions
- ❖ Quaternary: reproductive and/or physical death of animal

Means of measuring primary stress responses include:

- Neuroendocrine pathway – this involves nerves from the CNS promoting rapid (<5 seconds) secretion of catecholamines (adrenaline, noradrenaline) from chromaffin cells in the anterior kidney to the blood. The effects of which include:
  - Vascular and respiratory systems undertake an increase in oxygen uptake and utilisation, more blood is supplied to the muscles, liver and brain and haematocrit increases.
  - Glycogenolysis is stimulated causes an increase in the available glucose via the breakdown of stored glycogen.
  - Other effects include increased alertness, relax bladder and bowel sphincters and reduce salivation (terrestrial animals)

