

# Mosquitoes & Mosquito Borne Diseases



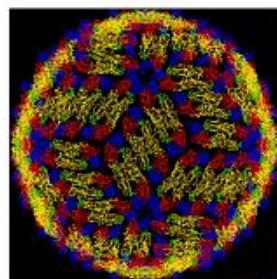
# Section A

# Mosquito Borne Diseases

## Dengue Fever

Dengue fever (DF) and dengue haemorrhagic fever (DHF) are mosquito borne viral diseases transmitted by the *Aedes* mosquito. There are 4 serotypes of the dengue virus (dengue 1, 2, 3, 4) which causes the disease. As there is no cross-immunity between the 4 serotypes, a person can be infected with dengue more than once.

Not all people who are infected will display symptoms. For those who do, common symptoms of DF include:



Dengue flavivirus (Image courtesy of Richard J. Kuhn and Michael G. Rossmann, Purdue University)

- **Headache**
- **Fever**  
usually lasting 2 to 7 days
- **Pain behind the eyes**
- **Nausea**
- **Vomiting**
- **Diarrhoea**
- **Rashes**
- **Muscle and joint pains**
- **Dengue haemorrhagic fever**

Dengue haemorrhagic fever is a more severe form of dengue. On top of the DF symptoms, the DHF patient also exhibits symptoms such as bleeding from the nose, mouth, and gums. Bruises may appear which can be a sign of internal bleeding. Death may occur in severe cases.

In severe cases, the patient's condition may deteriorate into Dengue Shock Syndrome (DSS). Circulatory failure is observed, and the patient may rapidly go into a critical state of shock. DSS may be fatal if appropriate treatment is not rendered promptly.

At present, there are no specific anti-viral drugs to treat the disease, nor is there a vaccine for dengue.

## Japanese Encephalitis

Japanese encephalitis is a viral disease that infects both animals and humans, and is transmitted by the *Culex tritaeniorhynchus* & *Culex gelidus* mosquito. Apart from humans, the virus may also be carried by wild birds and pigs.

Most infected people do not show any symptoms or have mild symptoms such as fever and headache. But in some severe cases, the patient may experience rapid onset of high fever, neck stiffness, disorientation, coma, seizures and spastic paralysis. The case fatality rate is high among those with symptoms, and even those who recover may suffer from lasting damage to the central nervous system.

There is no specific treatment for Japanese encephalitis.

## Malaria

Malaria is caused by the *Plasmodium* parasite, and is transmitted via the bite of an infected *Anopheles* mosquito. There are four types of malaria parasites that causes the disease.

The parasites multiply in the liver of the infected human, and then infect the red blood cells. The infected person displays symptoms such as fever, chills, nausea, headache and sweating. Infection by one of the malaria parasites, *Plasmodium falciparum*, is the most serious and can cause more severe symptoms such as renal and liver failure, shock and coma.

Malaria can be prevented and treated by taking anti-malaria medication.

## Chikungunya

Chikungunya fever is a viral illness that is transmitted by the bite of an *Aedes* mosquito.

The disease is characterised by severe, sometimes persistent, joint pain, as well as fever and rash at the trunk region.

No vaccine is available against this virus infection.

Symptomatic treatment is administered for mitigating pain and fever using anti-inflammatory drugs along with adequate rest. Full recovery of health and strength can be prolonged (up to a year or more), and persistent joint pain may require analgesic and long-term anti-inflammatory therapy.

## Vector Control in Singapore

In 1982, the World Health Organisation declared Singapore malaria-free, a status we had maintained up to today. Singapore was able to eradicate malaria, transmitted by the *Anopheles* mosquito, from its shores, due to sustained efforts to keep the *Anopheles* mosquito population in check. Such efforts are on going, even up to current day. Therefore, although Japanese encephalitis and other diseases transmitted by mosquitoes - Chikungunya (*Aedes*), Rift Valley fever (*Aedes*), West Nile fever (*Culex* & *Aedes*), etc, are not endemic to Singapore, it is nonetheless, imperative that we maintain vigilance in the control of the mosquito population, to avert the scenario of a local outbreak in the event the disease is introduced.



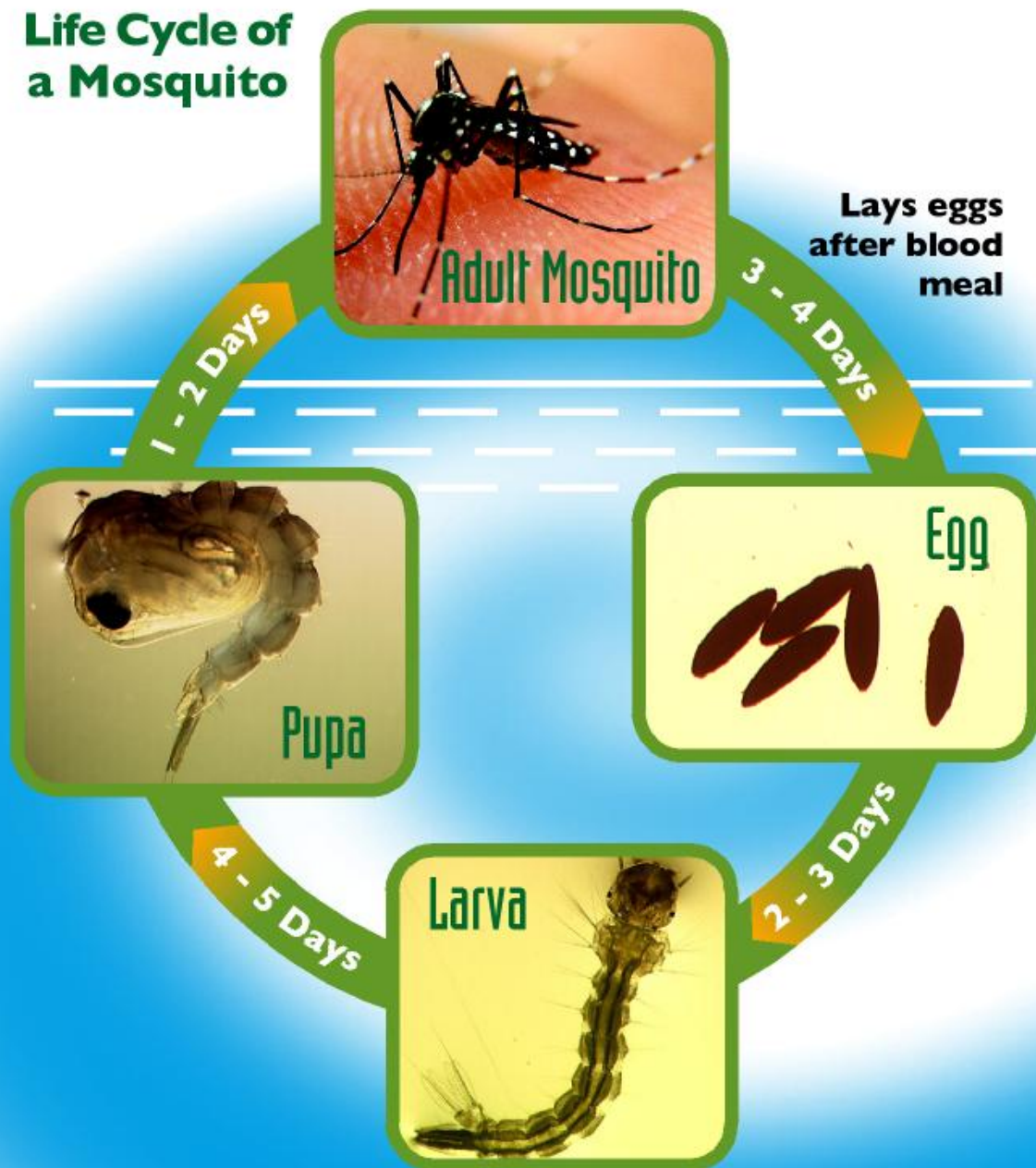
## Biology of the Mosquito


# Life Cycle

Mosquito undergoes a complete metamorphosis. Its life cycle passes through four different stages of development, namely, egg, larva, pupa and adult.


A complete development from egg to adult usually takes about 7 days. This period will vary according to the species of mosquito and the environmental conditions (temperature, sunlight, food, etc) present.

### Life Cycle of a Mosquito






**Egg** A gravid (with eggs) female mosquito would take a blood meal and around 2 days later, look for suitable places with water (habitat) to lay her eggs. On average, a mosquito can lay about 100 eggs or more after a full blood meal. *Aedes* eggs are more viable - they can survive in dry conditions for 6 months to a year. Once they are exposed to water, they will hatch to larvae and continue their life cycle.




**Larva** The larva has four developmental stages, namely, 1st, 2nd, 3rd and 4th instars. It grows bigger in size from 1st to 4th instars as it molts in water. The 1st instar larva is tiny, and may be seen as a little black dot moving about in the water. *Aedes* larvae may grow up to 10 mm in length. Larva usually takes about 4 to 5 days to become pupa.

The larva rises up to water surface for breathing by protruding its siphon above the water surface (such as *Aedes* and *Culex* larva) or through its spiracles (such as *Anopheles* larva). It moves through water by executing a wriggling motion, and is sensitive to external stimuli, usually moving away from light from a torch.



**Pupa** The pupa does not feed at this stage. It usually rests at the water surface to breathe, and waits to emerge to adult mosquito in 1 to 2 days.

The pupa moves in a tumbling manner, darting through the water. Like the larva, it is also easily disturbed by stimuli such as light and contact.



**Adult mosquito** The National Environment Agency's (NEA) research study showed that *Aedes* mosquitoes in Singapore could survive in the natural environment for about 2 to 3 weeks.

Only female mosquitoes suck blood, as they need the protein from the blood to mature their eggs. Factors that attract the female mosquito to its blood meal include body odour, carbon dioxide and heat emitted. Both male and female mosquitoes feed on nectar and plant juices for food.

In general, mosquitoes usually rest in cool, dark and humid places.

## Biology of the Mosquito

# Mosquito Species



There are more than 80 species of mosquitoes in Singapore. Many of these species of mosquitoes are uncommon and seldom pose a threat to health or well-being. The mosquitoes of major concern in Singapore belong to the genera *Aedes*, *Culex* and *Anopheles*. The *Anopheles* mosquitoes are usually found in undeveloped swampy and forested areas, while the *Aedes* mosquitoes commonly exist in urban or suburban areas. The *Culex* mosquitoes can be found ranging from urban to rural areas, depending on the species.

## *Aedes* mosquito

### *Aedes aegypti*

#### Physical appearance:

The adults are dark brown to black in colour with white stripes on their body and legs. The thorax has two distinct silvery white stripes.

**Biting habits:** Usually bites during the day.

#### Breeding habitats:

Breeds in clean stagnant water. Prefers to breed indoors, in domestic containers such as pails, flowerpot plates, vases, etc. Eggs are usually laid singly and adhere to the wall of receptacles just above the edge of the waterline.

#### Resting habits:

Prefers to rest indoors in cool dark places, on clothings, behind furniture and curtains.

**Transmits:** Dengue virus and Chikungunya virus.



*Aedes aegypti*

### *Aedes albopictus*

#### Physical appearance:

Body is strong black colour as compared to *Aedes aegypti*, with white stripes on their body and legs. Thorax has a distinct middle silvery white stripe.

**Biting habits:** Usually bites during the day.

#### Breeding habitats:

Prefers to breed outdoor in discarded containers, tree holes, bamboo stumps, ground depressions, canvas sheets, construction debris, etc. Eggs are usually laid singly.

**Resting habits:** Prefers to rest outdoor in vegetation.

**Transmits:** Dengue virus, Chikungunya virus, West Nile fever virus



*Aedes albopictus*

**Although both *Aedes aegypti* and *Aedes albopictus* transmit the dengue virus, *Aedes aegypti* is considered to be a more potent transmitter of the virus.**

**Culex mosquito****Physical appearance:** Greyish brown to dark in colour.**Biting habits:** Bites during the night.**Breeding habitats:**

Depending on species, they prefer to breed in dirty, organically polluted stagnant water or in clear water. Eggs are laid in the form of rafts on the water surface.

**Transmits:**

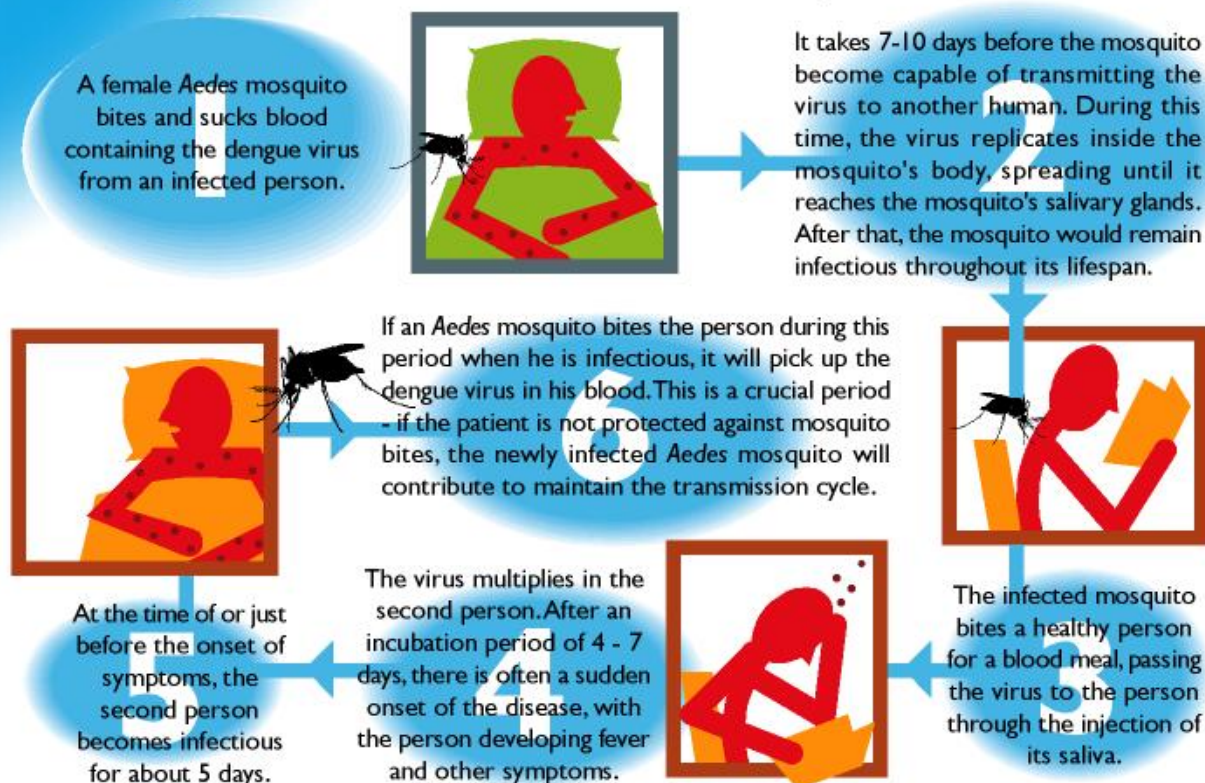
Japanese encephalitis virus, Lymphatic Filariasis, West Nile virus.

*Culex quinquefasciatus***Anopheles mosquito****Physical appearance:**Body colour varies from species to species. *Anopheles sundaicus* and *Anopheles maculatus* are brown in colour. Their wings and legs are spotted and covered with pale and dark scales**Biting habits:**

Bites during the night.

**Breeding habitats:** Breeds in seepages or brackish water, depending on the species. Eggs are laid singly.*Anopheles maculatus***Transmits:** Malaria.

# Dengue Transmission Cycle



# SECTION B



- Chapter 1**  **Town Council Estates**
- Chapter 2**  **Condominium Estates & Apartments**
- Chapter 3**  **Construction Sites**
- Chapter 4**  **Worker Dormitories**
- Chapter 5**  **Factories & Shipyards**
- Chapter 6**  **Other Premises**

## Common Mosquito Breeding Places

This Section provides a reference of common places within town council estates, condominium estates and apartments, construction sites, worker dormitories, factories and shipyards and other premises, where mosquito may breed. Measures are recommended to prevent or treat mosquito breedings, and users are strongly advised to adopt permanent measures, as they address and eliminate the root cause of the mosquito breeding.

Although the chapters aim to be comprehensive and complete, they are by no means exhaustive. Users should not rely solely on this reference alone for their mosquito control, but rather focus their efforts on rendering their premises unfavourable for mosquito to breed by eliminating all bodies of stagnant water: