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MOSQUITO-BORNE DISEASES IN MISSISSIPPI

Ryan J. Rodriguez
University of Nebraska-Lincoln

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MOSQUITO-BORNE DISEASES IN MISSISSIPPI

Ryan J. Rodriguez

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Insect Characteristics

- There are several key characteristics that distinguish insects from other arthropods
 - Body with 3 distinct regions: head, thorax and abdomen
 - One pair of antennae
 - 3 pairs of legs that are attached to the thorax



Classification of Mosquitoes

Kingdom

Animalia

Phylum

Arthropoda

Class

Insecta

Order

Diptera

Suborder

Nematocera

Genus

Culex spp.

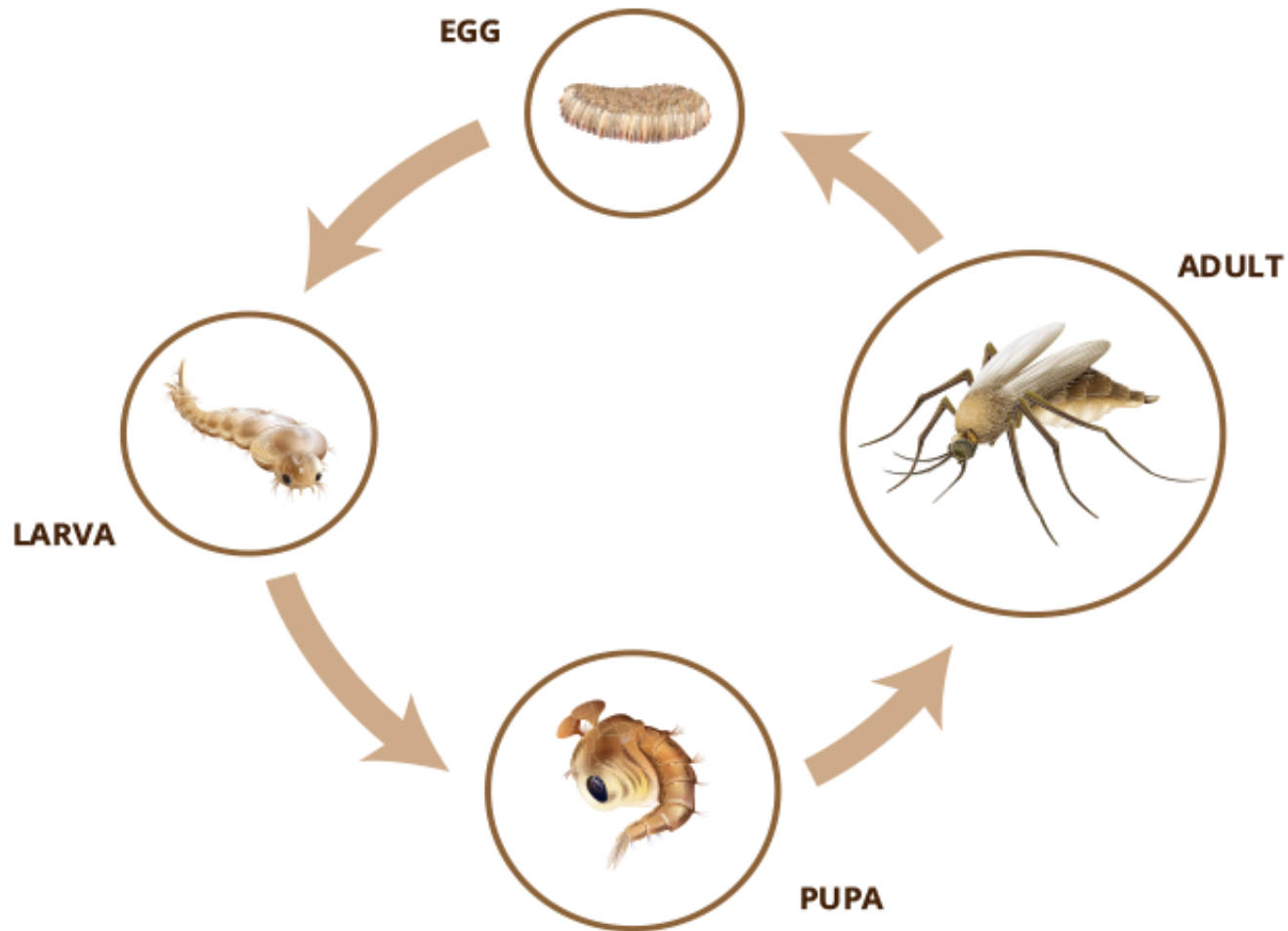
Aedes spp.

Anopheles spp.

Life Cycle

- Egg
 - Must be exposed to water to hatch
- Larvae
 - Live in aquatic habitats
- Pupa
 - Stay near the surface of water to breath
- Adult
 - Only females feed on blood
 - Males feed on nectar

Life Cycle



Egg

- Mosquito eggs must be exposed to water for them to hatch
- Different species use different water habitats to breed
- There are 3 types of water habitats that mosquitoes breed in
 - Permanent Water Breeders
 - Flood Water Breeders
 - Artificial Container Breeders



Mosquito Egg



Mosquito Larvae

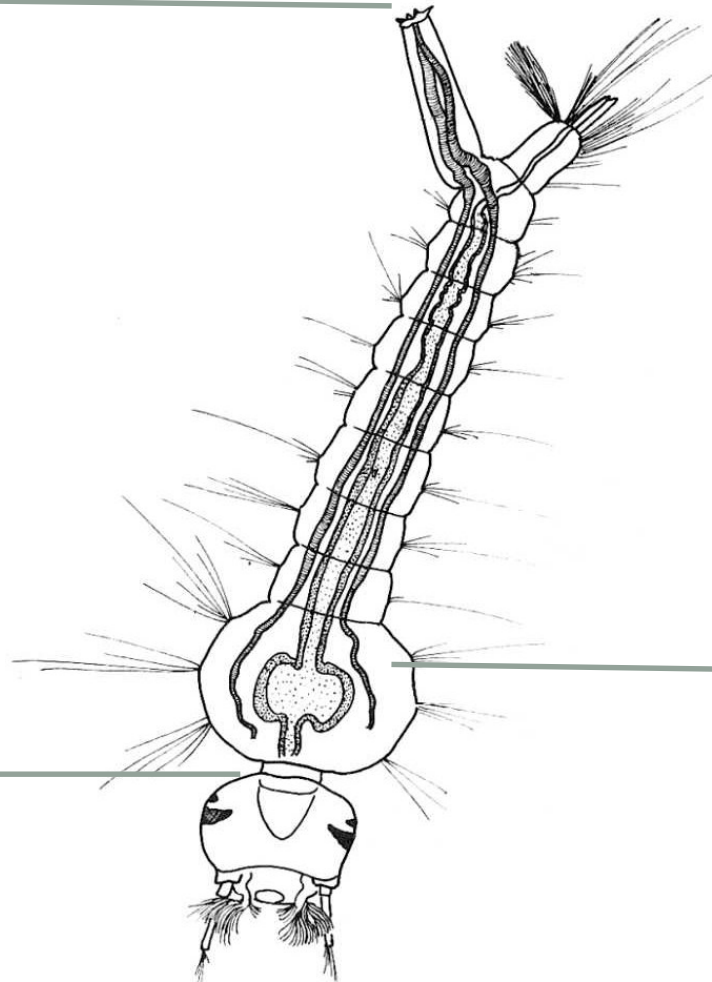
- Most mosquito larvae have a structure at their posterior that lets them breathe
- Larvae have no legs but swim by moving their bodies in a jerking manner
- Larvae molt 4 times
- Larvae eat other insects or feed on algae
- When threatened, some larvae dive in the water

Mosquito larvae

Air Tube

Head

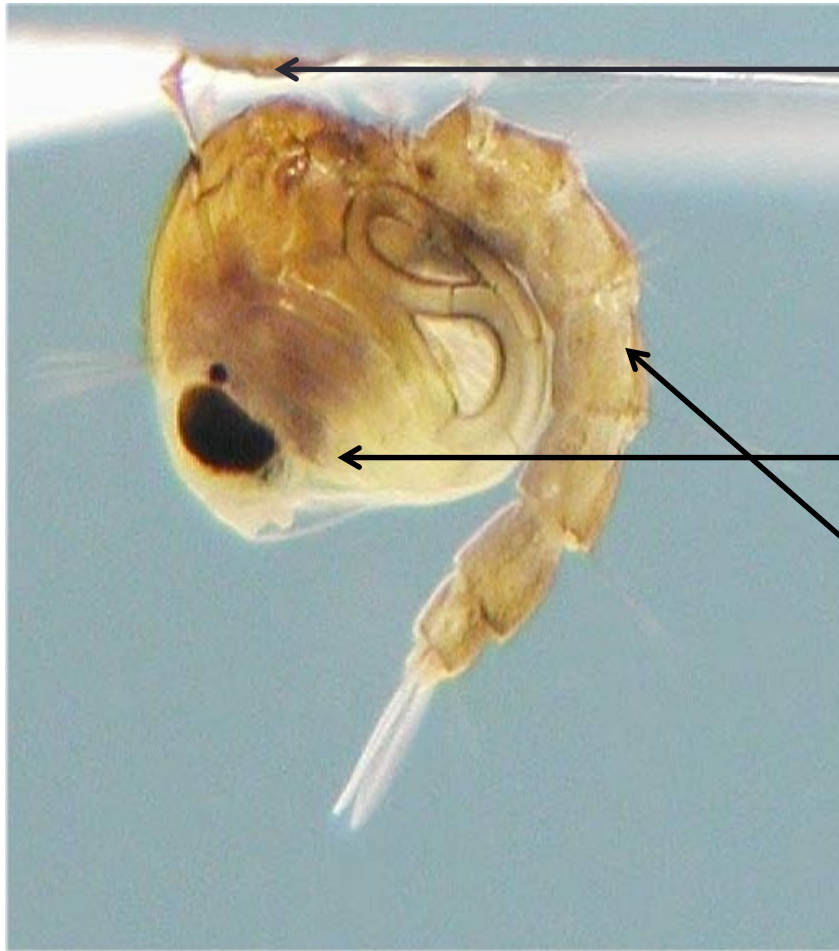
Thorax



Mosquito Pupae

- Mosquito pupae do not feed
- Pupae spend most of their time near the water surface
- Pupae are mobile
- Pupae dive into the water to avoid danger
- Usually last 2 days depending on temperature

Mosquito Pupae



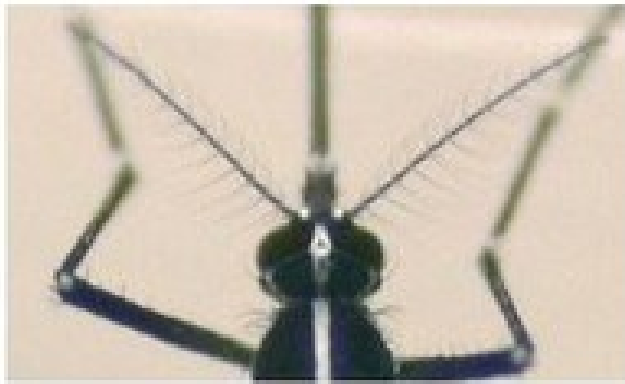
Air trumpet

Cephalothorax

Abdomen

Adult Mosquito

- Adults are terrestrial
- 1 pair of wings
- Males have plumose antennae and females have non-plumose antennae

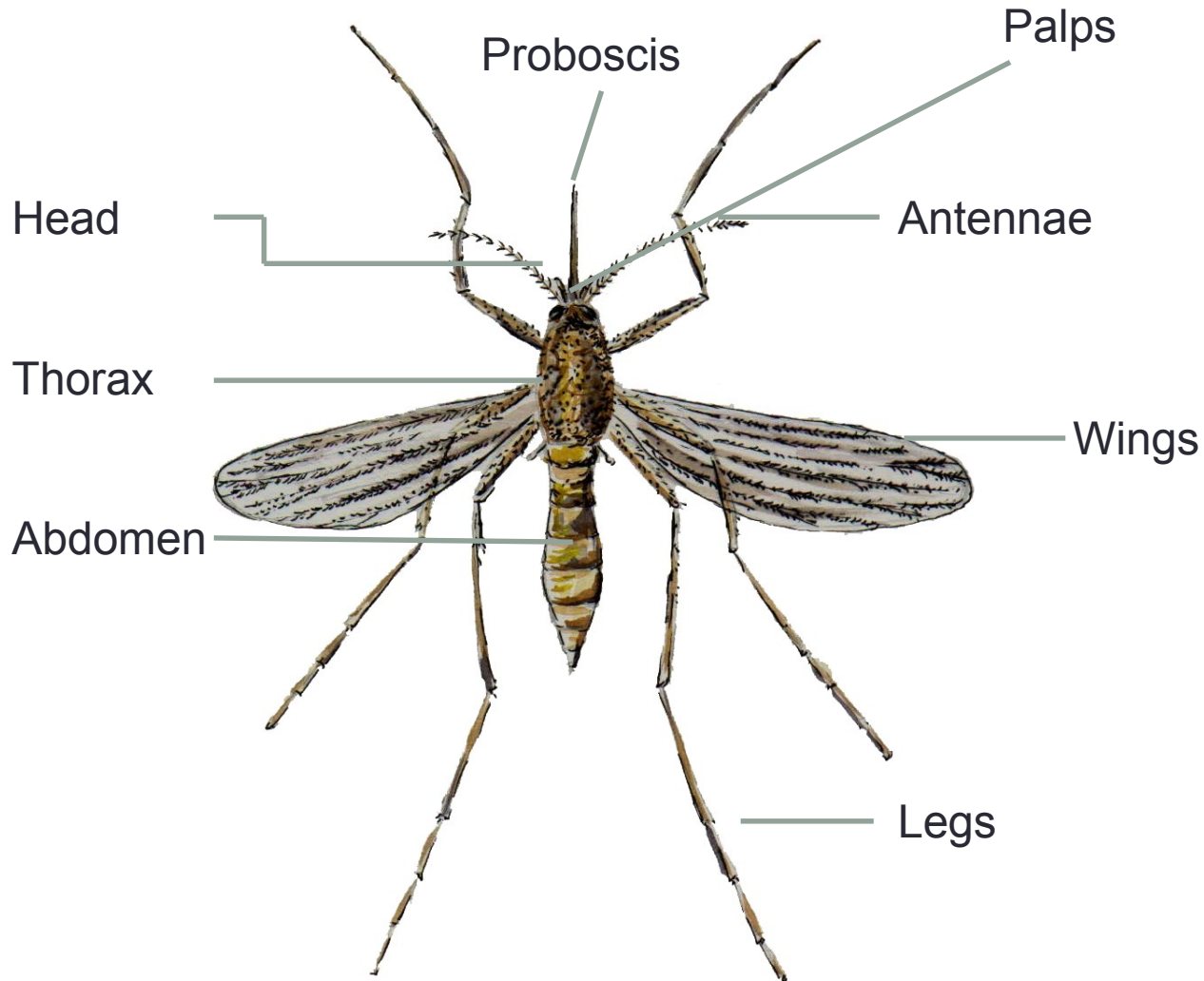


Female

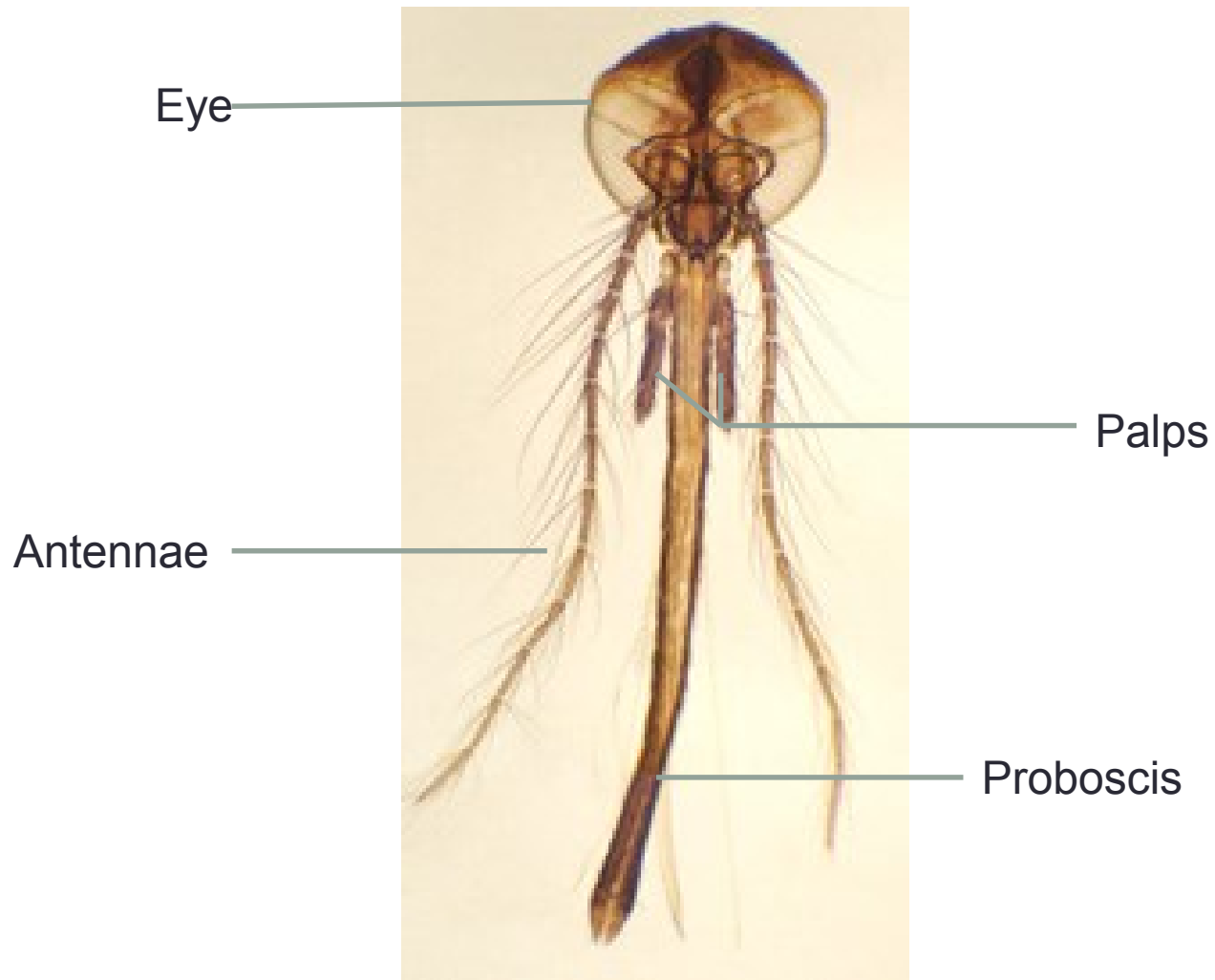


Male

Adult Mosquito Body Parts



Mosquito Head



What Do Mosquitoes Eat?

- Males feed on nectar
 - Nectar gives mosquitoes the necessary nutrients to survive
- Only females feed on blood
 - Blood has nutrients for females to produce eggs

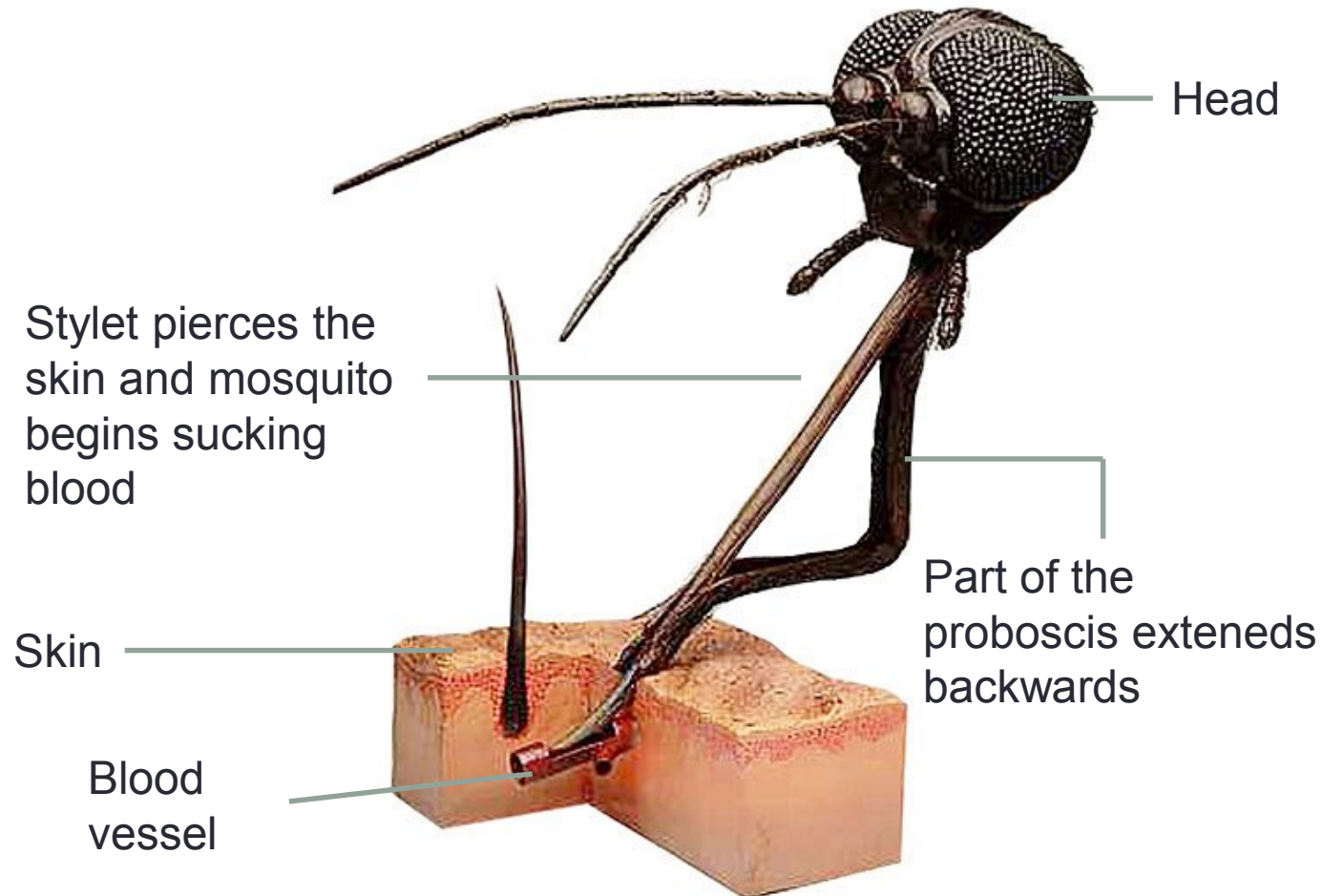


How do Mosquitoes Find You?

- Mosquitoes are attracted to temperature, carbon dioxide and lactic acid
- They use their antennae and other receptor cells to locate a host
- Once a mosquito is close enough, it uses its eyes to confirm if a host is suitable

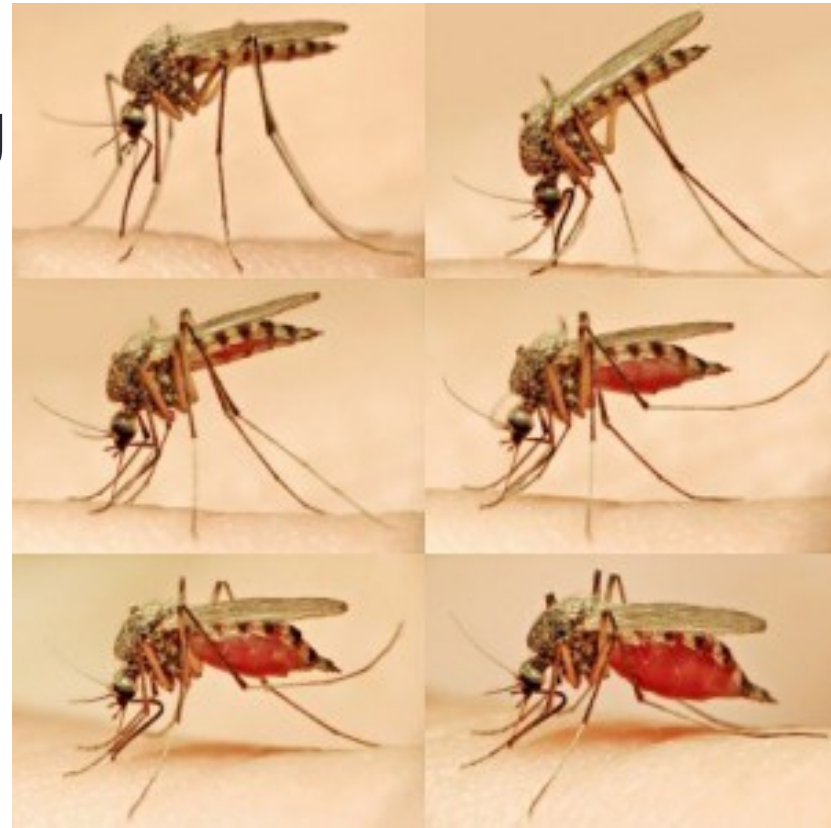


How do Mosquitoes Drink Blood?



What Happens After They Feed?

- Once a female takes a blood meal it will fly away to rest and digest the blood for egg production
- After feeding, the mosquito will not seek another blood meal
 - They feel “full”



Feeding Habits of Mosquitoes

- Some mosquitoes prefer to feed indoors, and some mosquitoes prefer to feed outdoors
 - Endophagic- feed indoors
 - Exophagic- feed outdoors
- After feeding, the female usually likes to rest
 - Endophilic- rest indoors (on walls, under the sofa etc.)
 - Exophilic- rest outdoors (on trees, under leafs, etc.)

Public Health

- Besides being a nuisance, they cause numerous health hazards to humans (and other animals)
- In some cases, they may cause severe allergic reactions
- Diseases they transmit:
 - Eastern Equine Encephalitis
 - Japanese Encephalitis
 - La Crosse Encephalitis
 - St. Louis Encephalitis
 - West Nile Virus
 - Western Equine Encephalitis
 - Dengue Fever
 - Malaria
 - Rift Valley Fever
 - Yellow Fever

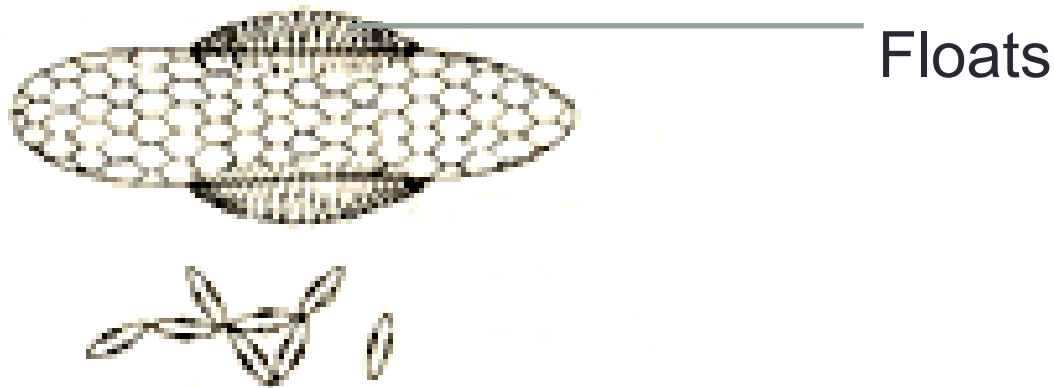
Mosquito-Borne Diseases in Mississippi and its Vectors

- Chikungunya Virus
 - *Aedes* species
- Eastern Equine Encephalitis
 - *Culex* and *Aedes* species
- St. Louis Encephalitis
 - *Culex* species
- La Crosse Encephalitis
 - *Aedes* species
- West Nile Virus
 - *Culex* species
- Malaria
 - *Anopheles* species



Anopheles Eggs

- Females lay eggs on the water's surface
 - Eggs are laid singly
 - Have floaters on their side
- Eggs are Direct-Hatching
 - Eggs will not survive if the environment is dry



Anopheles Larvae

- Most *Anopheles* species prefer clean water
- Can be found in fresh or salt water, streams, and puddles
- Breathe through spiracles located in the abdomen's posterior

Anopheles Larvae



- Has no airtube
- Rests parallel to the water

Anopheles Pupae



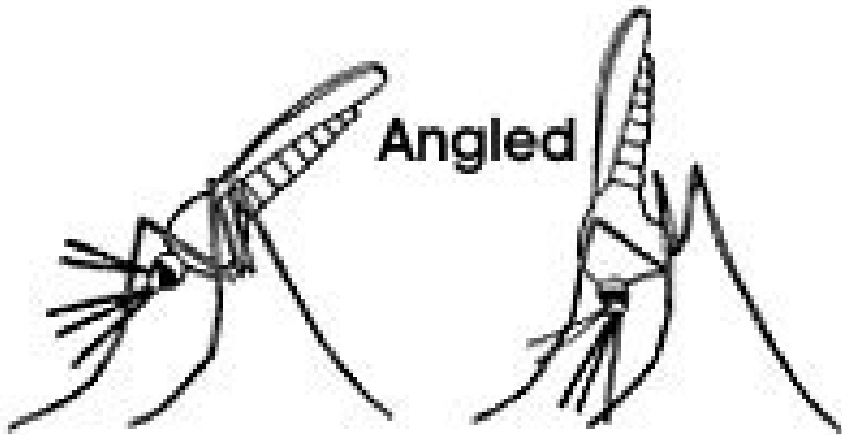
- Most of its body touches water surface
- Air trumpet short and cone shaped

Female Adult *Anopheles*



- White, pale in color
- Scales on wings
- The palps are almost as long as the proboscis

Female Adult *Anopheles*



- Rest at an angle
- Some species rest at a 90 degree angle

Aedes Eggs

- Eggs are usually black, laid singly above the water
 - *Aedes* eggs can withstand desiccation
 - Eggs are Delayed-Hatching
- Eggs hatch when they come in contact with water



Aedes Larvae

- Larvae feed on algae and other microscopic organisms
- They will swim to the bottom if disturbed
- Live in puddles, or any object that can contain water
- Have 4 instars

Aedes Larvae



- Short Air Tube
- Body rests at an angle

Aedes Pupae



- Body barely touches the surface

Female Adult *Aedes*



- Palps are shorter than proboscis
- Thorax has black and white scales
- Legs have white and black rings

Female Adult *Aedes*

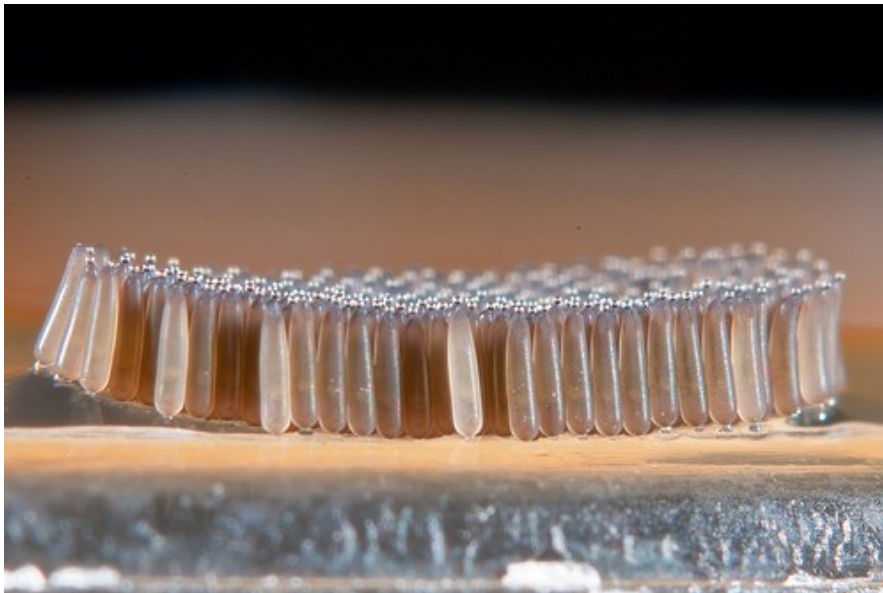
Horizontal



- Adults rest at a horizontal position
- Body is close to the surface

Culex egg

- Eggs are brown and cylindrical in shape
- Eggs are laid upright on the water surface in rafts which can contain up to 300 eggs



Culex Larvae

- Longer curved air tube compared to *Aedes* species
- Head short and stout and becomes darker at the end

Culex Larvae



- Longer Air Tube
- Rests at an angle

Culex Pupae



- Less of the pupae's body touches the water surface
- Air trumpet long and slender

Female Adult *Culex*



- Thorax, legs and wings usually covered in brown scales
- Palps are shorter than proboscis
- Identifiable because it lacks unique characteristics

Female Adult *Culex*

Horizontal



- Females rest at a horizontal position
- Body is further from the surface compared to *Aedes* species

Allergic Reaction

- Everyone experiences some sort of allergic reaction
- The saliva of the mosquito is what causes the allergic reaction
- Most people just experience a red protuberance that itches
- However, some people have severe allergic reactions such as intense swelling, itching, and in some cases, infections may develop

Allergic Reaction



Malaria

- Malaria is one of the oldest mosquito-borne diseases in the world
- By 1951, malaria was considered eradicated from the United States
- Cases of malaria still occur in the United States
 - Returning travelers or immigrants that have malaria can infect mosquito



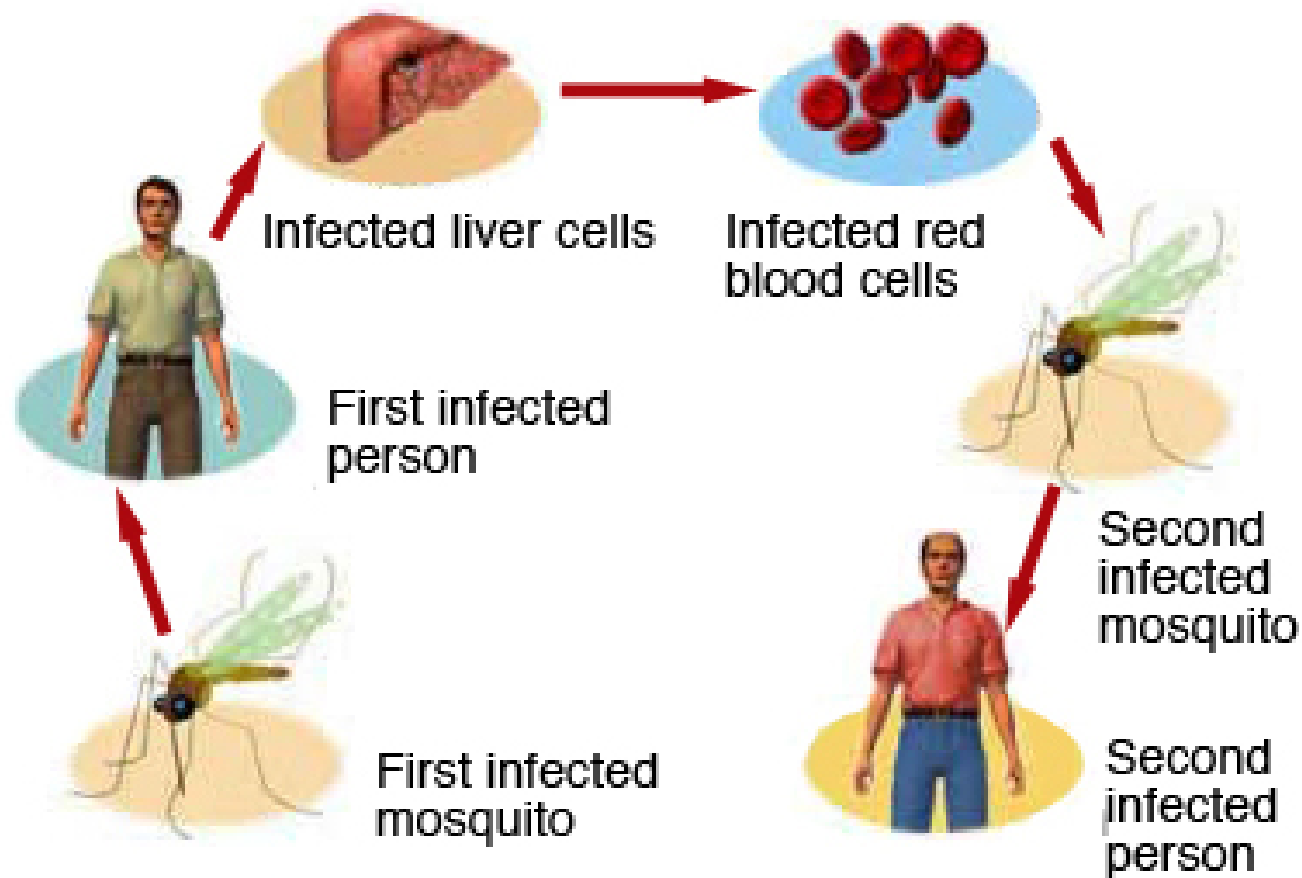
Malaria Symptoms

- Fever, chills, sweats, headaches, nausea, vomiting and body aches
- Patients may develop severe symptoms
 - Serious organ failures
 - Destruction of red blood cells
 - Seizures, coma, cerebral malaria
- Symptoms more severe in young children and pregnant women

Malaria Transmission

- The malaria parasite is transmitted to people when an infected *Anopheles* mosquito bites a person
 - The malaria parasite infects the liver cells and then enters the bloodstream attacking red blood cells
- Malaria could be transmitted from a mother to her child before or during child birth
- Since malaria is found in red blood cells, malaria could be transmitted through blood transfusion

Malaria Transmission



St. Louis Encephalitis (SLE)

- This is the most common mosquito-borne disease in Mississippi
- More than 2,000 cases were reported in 1975 throughout the United States
- Mainly affects the elderly
- Occurs mostly in summer and early fall
- 15% of people affected with severe symptoms die

SLE Symptoms

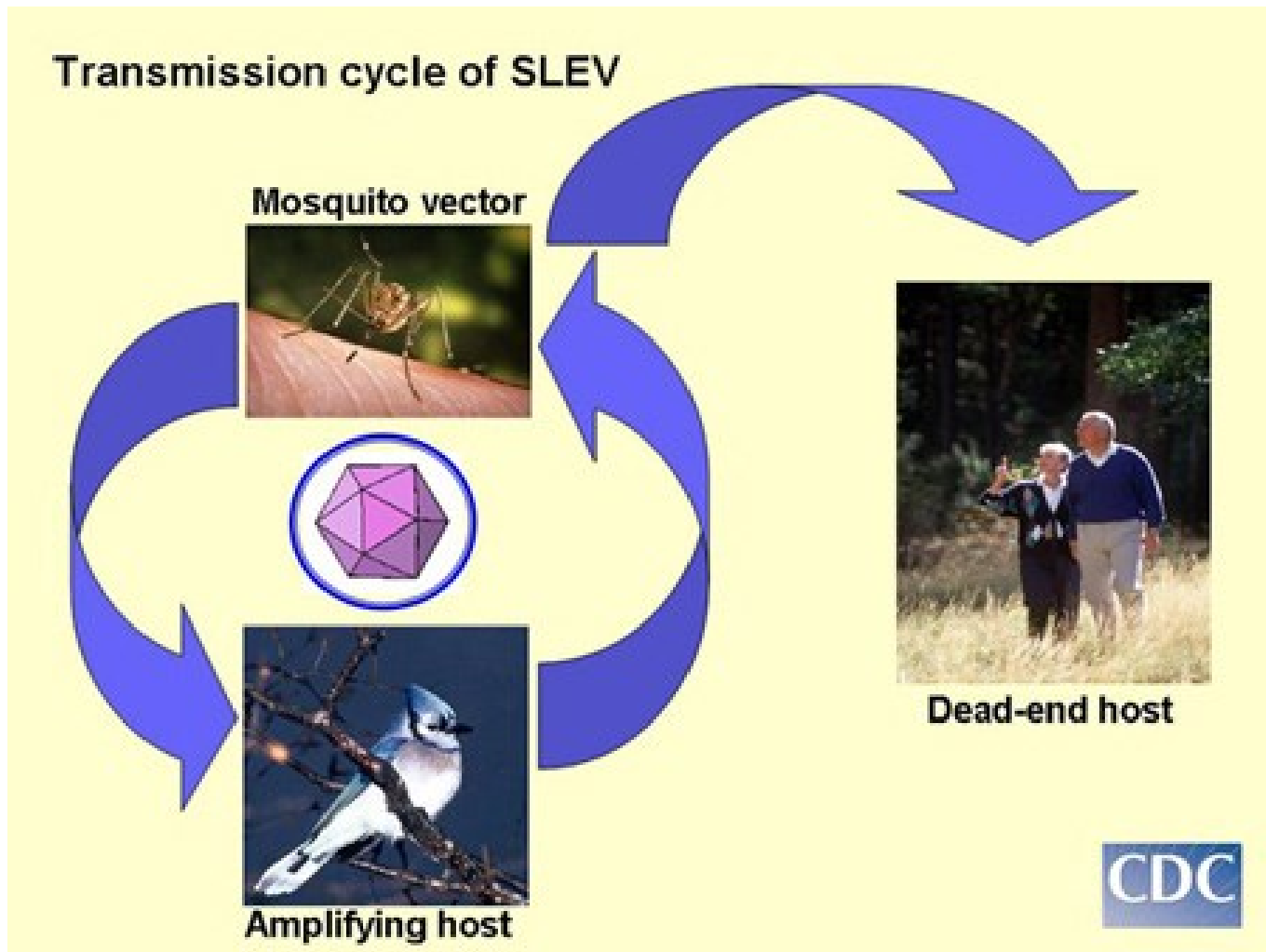
- Fever, headache, dizziness and nausea
- Symptoms may become more severe as the illness develops
- Older adults generally have worse symptoms than children
- Elderly people with SLE may develop encephalitis
- 5-15% of cases become fatal

Transmission of SLE

- Mosquito Vector: *Culex* species
- Transmission cycle is generally maintained between birds and mosquitoes
 - Bird hosts: pigeon, blue jay, and robin
- Humans and domestic mammals can acquire SLE infection, but they are dead-end hosts



Transmission of SLE



West Nile Virus (WNV)

- WNV occurs in horses, birds, mosquitoes
- Elderly are more affected
- Humans affected may develop encephalitis or meningitis
- WNV may be fatal among people who have severe symptoms

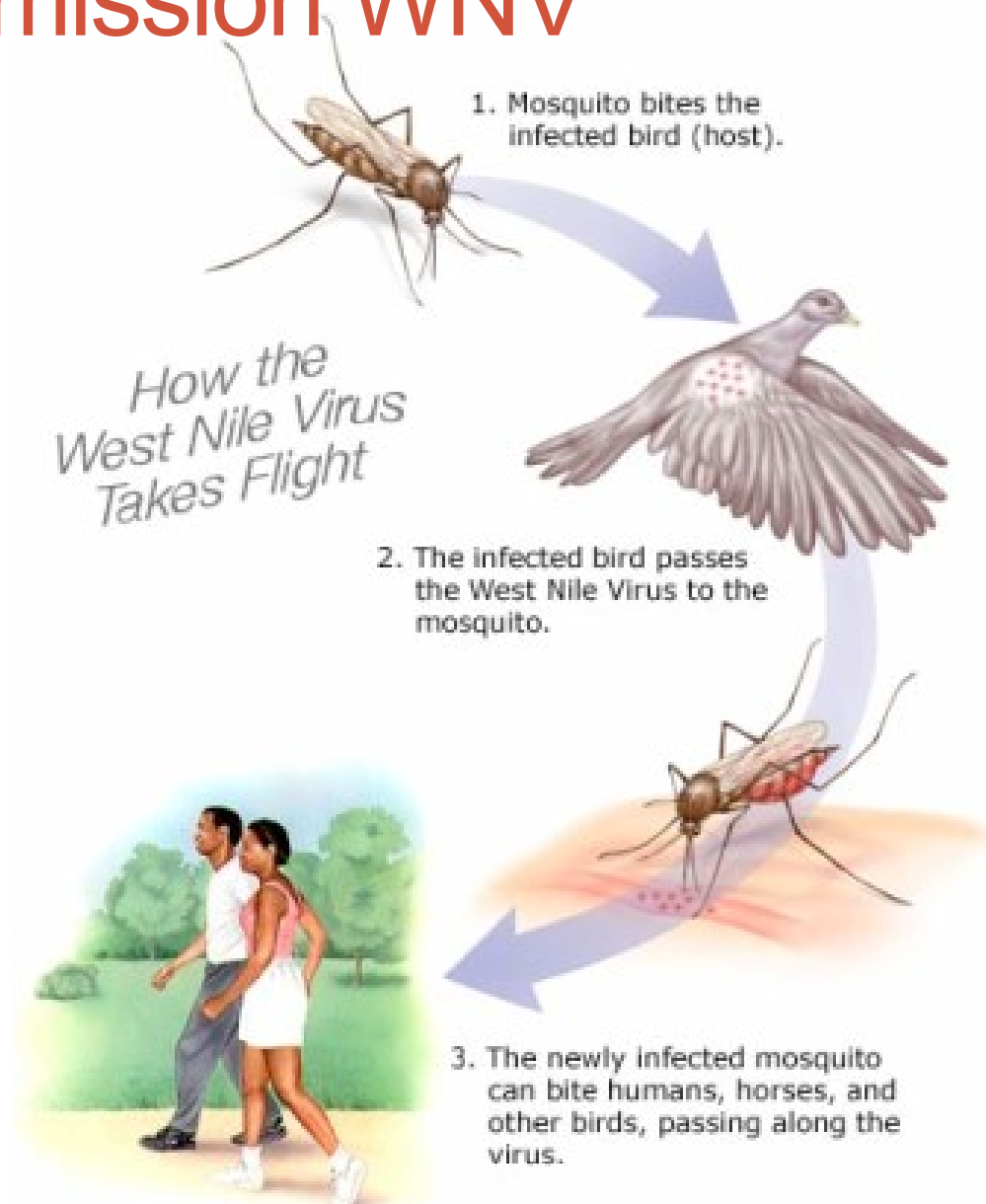
WNV Symptoms

- 70-80% of people infected do not develop symptoms
- Headache, joint pain, vomiting, diarrhea, or rash
- Only a few people (1%) develop severe symptoms (neurologic illness)
 - Encephalitis or meningitis
- Elderly people are at greater risk for severe symptoms
- 10% of people that develop neurologic illness die
- In some cases, neurologic illness may become permanent

Transmission WNV

- Mosquito vector: *Culex* species
- In nature, WNV cycles between birds and mosquitoes
 - Mosquitoes become infected while feeding on an infected bird
 - Infected mosquitoes can transmit the virus to uninfected birds
 - When an infected mosquito feeds on a human it transmits the virus to the human
 - Infected humans cannot pass the virus to other mosquitoes

Transmission WNV



La Crosse Encephalitis (LAC)

- Few reported cases in Mississippi
- Generally occurs from spring to fall
- Adolescents are more susceptible to LAC
- Fatal cases are rare



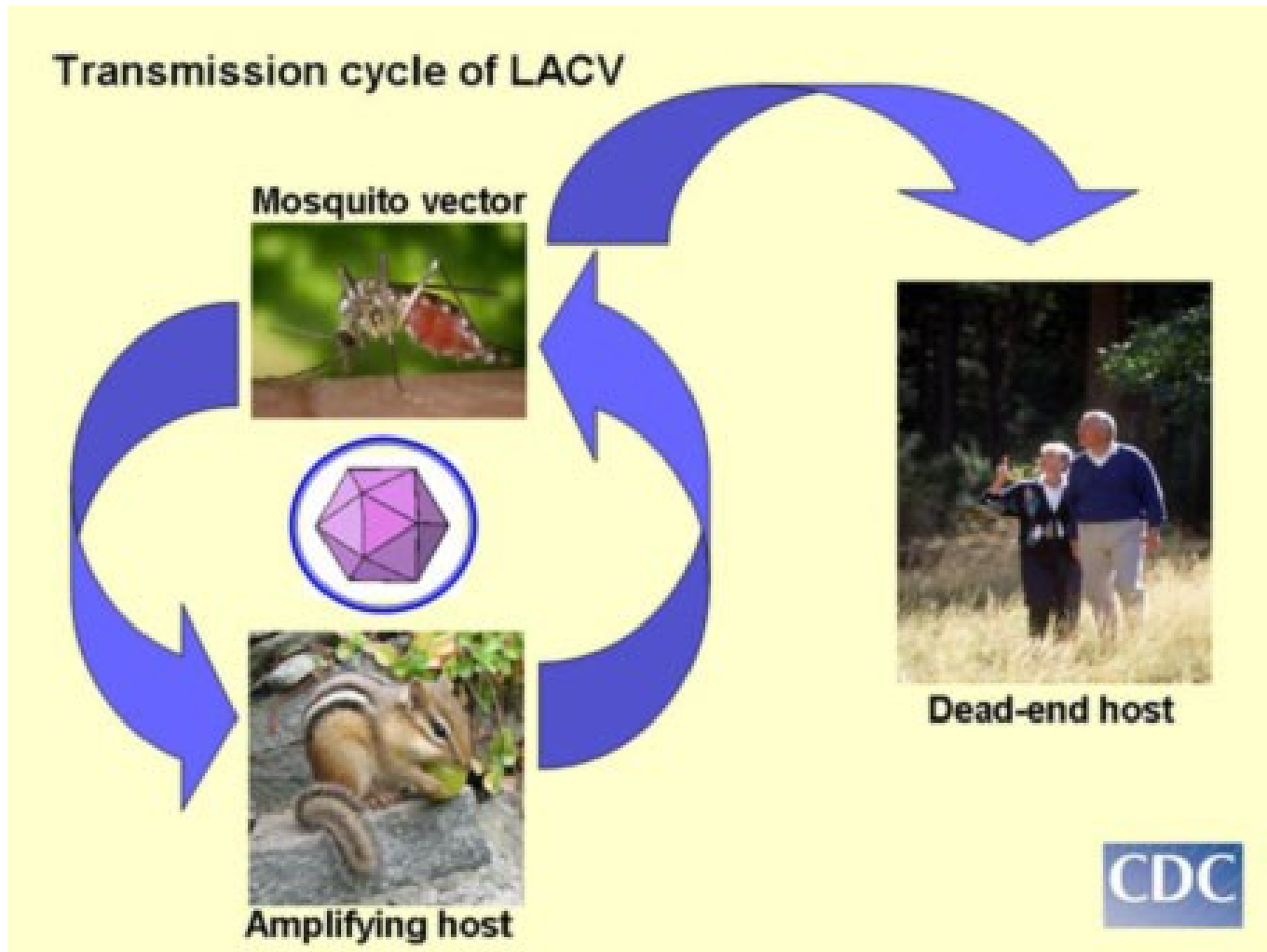
LAC Symptoms

- Fever, headache, nausea, vomiting and fatigue
- Severe neurological symptoms may occur
 - Severe symptoms occur mostly in children
 - Seizures may occur in patients with neurological symptoms
- Mortality is less than 1%
- Some people that have developed neurological symptoms may have recurrent seizures

Transmission of LAC

- Mosquito vector: *Aedes* species
- Transmission cycle is maintained between mosquitoes and vertebrate hosts
 - Chipmunks and squirrels
- Humans become infected when an infected mosquito feeds on them
- Infected females transfer the virus to their eggs

Transmission of LAC



Eastern Equine Encephalitis (EEE)

- Occurs in birds, horses and humans
- Few human cases reported in Mississippi
- Children are more susceptible to severe symptoms
- 30-60% of people affected with EEE die



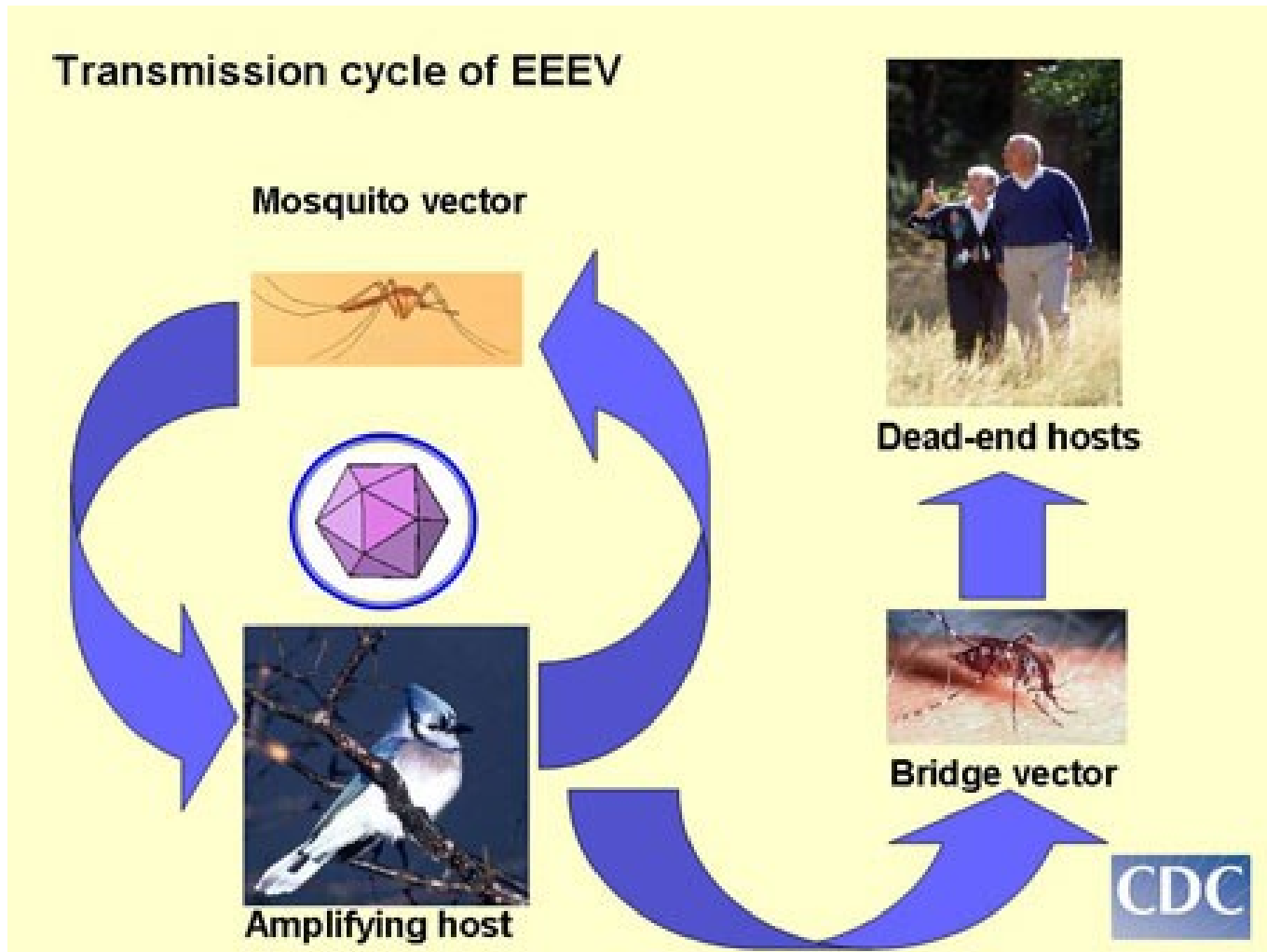
EEE Symptoms

- People may not develop symptoms
- Fever, joint pain, muscle pain
- Severe symptoms and neurological illness may occur
 - Encephalitis, convulsions, and coma
- 3% of affected people die
 - Death occurs within 2-10 days after symptoms develop
- People that recover from EEE may develop seizures, personality disorders, intellectual impairment, paralysis, and cranial nerve dysfunction

Transmission of EEE

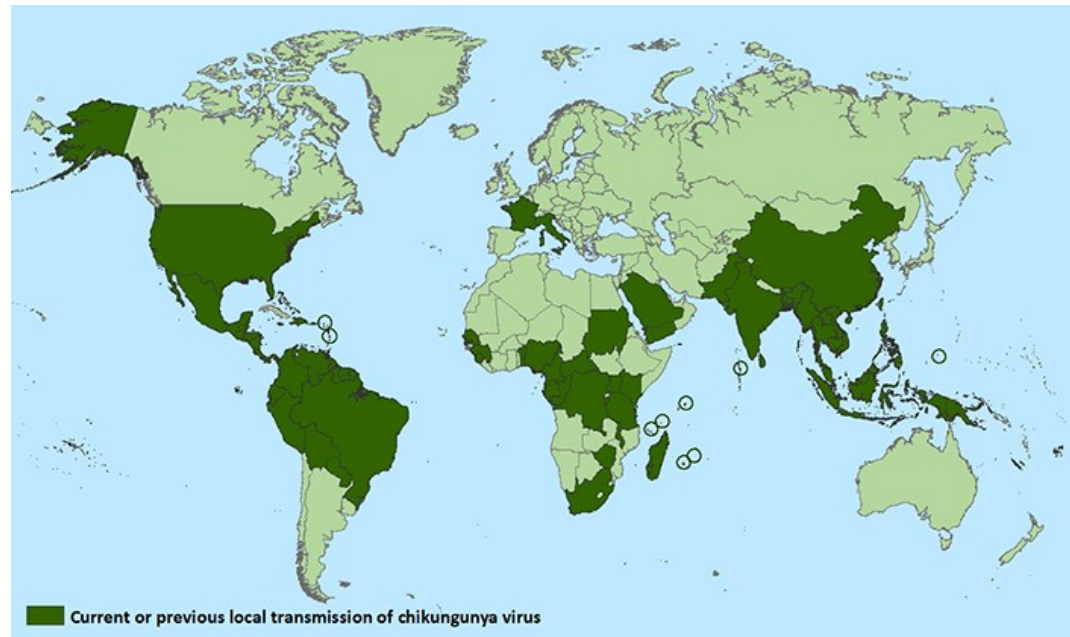
- Mosquito vector: *Culiseta melanura*
- *C. melanura* is not considered an important vector to humans.
 - It feeds almost exclusively on birds
- Transmission to humans is caused by *Aedes* and *Culex* species
 - They are considered “Bridge Vectors”
- Humans are dead-end hosts

Transmission of EEE



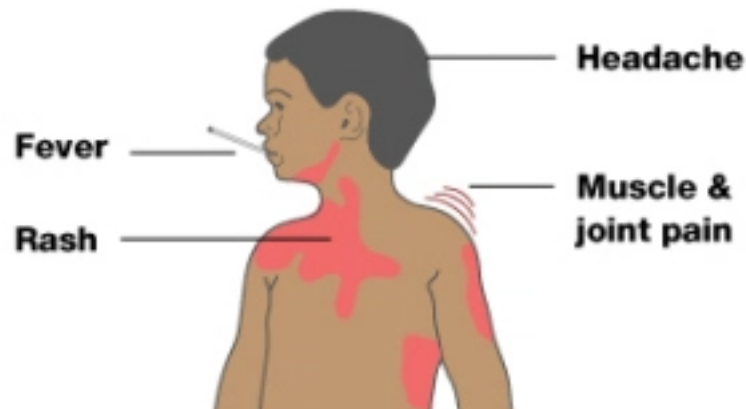
Chikungunya Virus

- First case was reported in 2014
- Cases have been reported in Mississippi from residents who have traveled to the Caribbean
- Rarely fatal



Chikungunya Symptoms

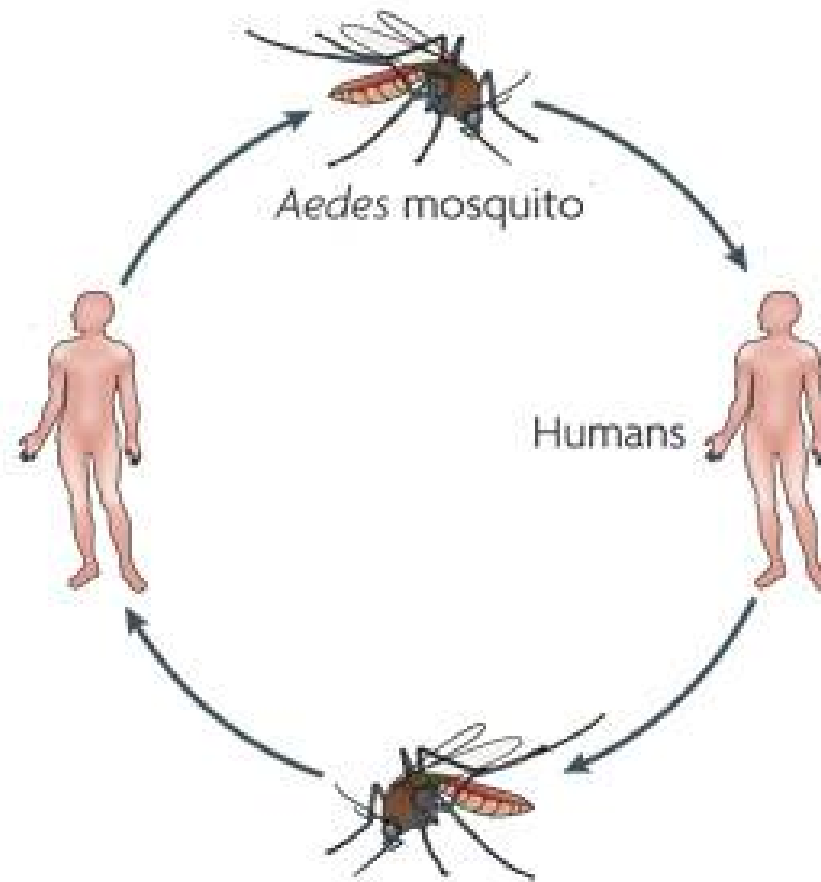
- Fever, joint pain, headache, muscle pain, joint swelling, or rash
- Symptoms and severity vary from person to person
- Severe symptoms are more probable in older adults, people with high blood pressure, diabetes, or heart disease



Transmission of Chikungunya

- Mosquito vector: *Aedes* species
- Mosquitoes become infected when they feed on an infected human
 - Mosquitoes transmit the virus when they feed on an uninfected human
- There have been some cases (rarely) in which the virus has been transmitted from mother to newborn child

Transmission of Chikungunya



Treatment

- Currently there is no vaccines for Chikungunya, EEE, WNV, LAC, SLE
- Use of pain relievers
- Patients with severe symptoms must be hospitalized



How do you Control Mosquitoes?

- It's impossible to eliminate all mosquitoes but using multiple control methods will prevent mosquito bites and reduce mosquito populations
- Knowing the life cycle of the mosquito species will help determine an effective control method
- Prevention and Control methods
 - Preventative Measures
 - Insect Repellents
 - Biological Control
 - Chemical Control
 - Physical Control

Protection and Prevention

- Stay indoors and close windows or use window screens to avoid mosquito entry
 - Use of mosquito nets
- Empty containers that may contain water
 - Flower pots, tires, buckets
- Wear long-sleeved shirts, closed shoes, and long pants
- Infected people may have to be quarantined
 - Prevents mosquito vectors from acquiring the disease
- Use insect repellents



Insect Repellents

- Repellents make humans unattractive to mosquitoes
- Repellents that contain DEET, picaridin, IR3535 are the best long-lasting repellents
- Read the label of the repellent for instructions on where and how often should it be applied



Biological Control

- Use of predators, parasites or pathogens to reduce mosquito populations
- Mosquitofish, *Gambusia spp*, is a fish that feeds on mosquito larvae
- The predatory *Toxorhynchites* mosquito larvae eat other mosquito larvae
- These predators have limited success controlling mosquito larvae

Biological Control



Mosquitofish



Predatory *Toxorhynchites*
larvae

Chemical Control

- Use of chemicals (pesticides) to reduce pest populations
- The most efficient way to control mosquitoes is to use larvicide (kill larvae)
 - Larvicides are applied in the water
- Adulticides (target adult mosquitoes) are applied where the adults rest
 - Usually applied over large areas
- It is easier to control the larvae because they are confined to their aquatic habitat
 - Adults can fly far distances making it difficult and costly to apply pesticides

Chemical Control



Spraying larvicide



Spraying adulticides

Physical Control

- Manipulate the environment to make it unfavorable for the mosquito
- Mosquitoes usually breed in shallow water
 - Temporary bodies of water, containers, puddles etc.
- Easiest way is to empty the containers of water to prevent breeding habitats and kill larvae and pupae living in the containers

Physical Control



→ - Larvae in containers

-Remove water from
containers

Summary

- General insect characteristics
- Mosquito taxonomy and biology
- Mosquito feeding
- Mosquito-borne diseases
- Vectors and disease transmission
- Preventative measures and control

QUIZ

Click on Answer

Question #1

- *Aedes* species does not transmit which disease?

Chikungunya

La Crosse Encephalitis

West Nile Virus

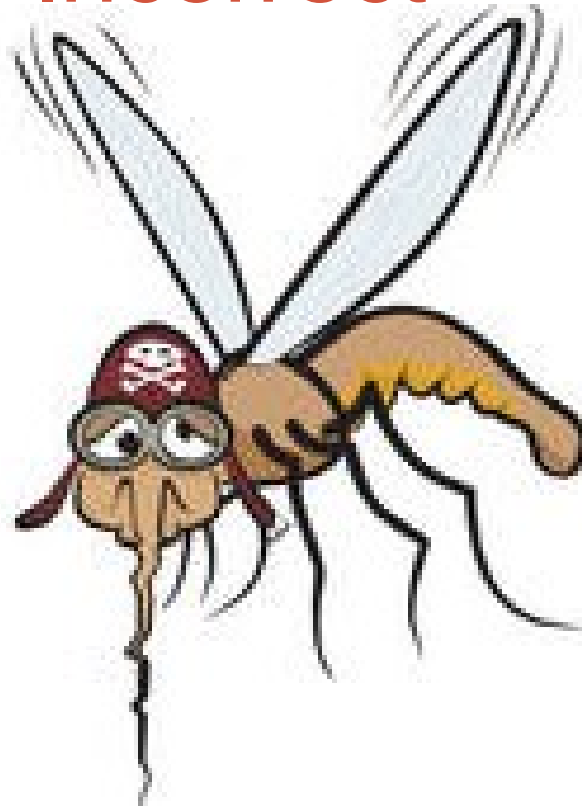
Eastern Equine
Encephalitis

Correct!



Next Question

Incorrect



Try Again?

Yes

No

Question #2

- One of the best ways to reduce mosquito populations is to empty containers of water

True

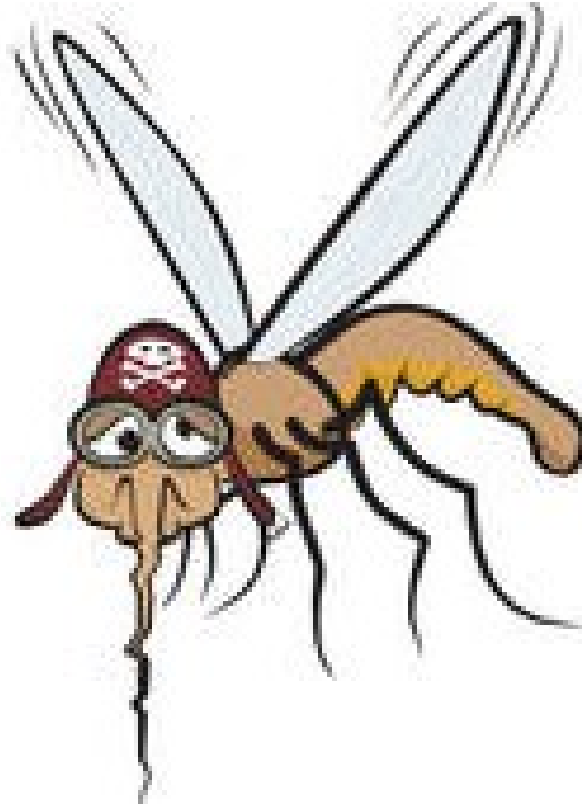
False

Correct!



Next Question

Incorrect



Try Again?

Yes

No

Question #3

- Both males and female mosquitoes feed on blood

True

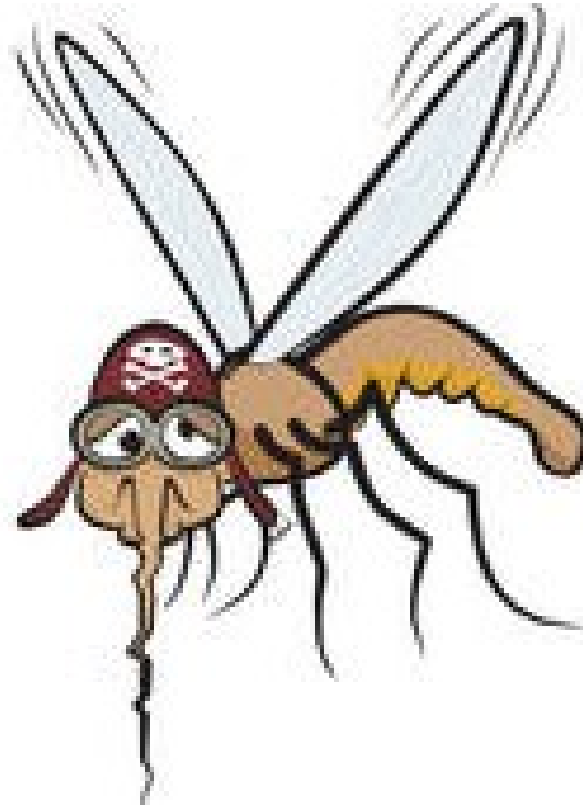
False

Correct!



Next Question

Incorrect



Try Again?

Yes

No

Question #4

- Chikungunya is transmitted when a mosquito acquires the virus from a bird then feeds and passes the virus to a human

True

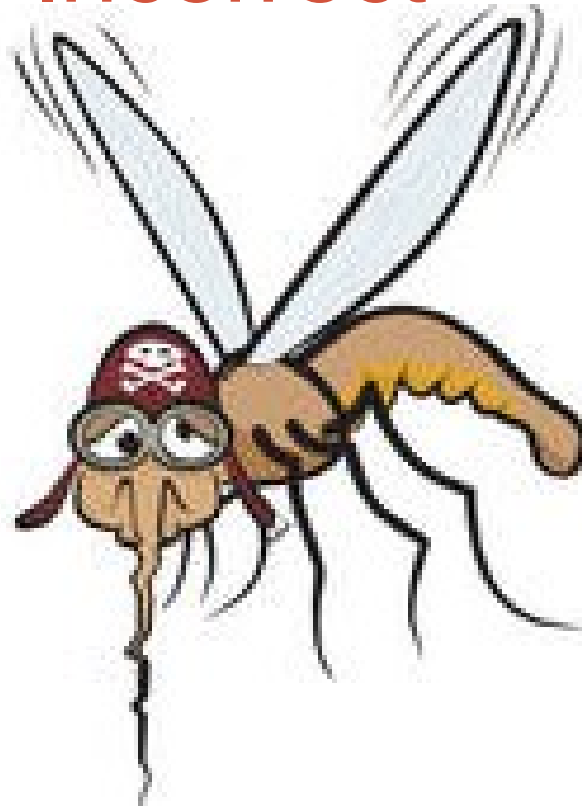
False

Correct!



Next Question

Incorrect



Try Again?

Yes

No

Question #5

- Which mosquito-borne disease was considered eradicated from the United States ?

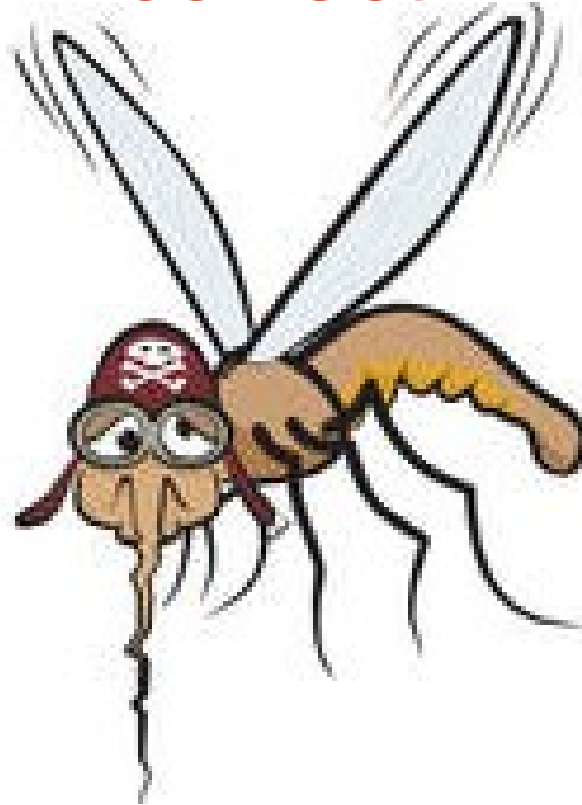
Malaria

Chikungunya

West Nile Virus

Eastern Equine
Encephalitis

Incorrect



Try Again?

Yes

No

Correct!



Fin

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