

*School intervention for vectorborne diseases in Maine:  
Program to educate grades 3-8 on mosquito-borne diseases and prevention methods*

# Fight the Bite!

Maine Center for Disease Control and Prevention



# FIGHT THE BITE!

## OVERVIEW:

Mosquitoes can carry several viruses which can cause diseases in humans and animals. The three main viruses in Maine that are transmitted by mosquitoes are Eastern Equine Encephalitis (EEE) virus, Jamestown Canyon virus (JCV), and West Nile virus (WNV).

The Public Health Educators within Maine Center for Disease Control and Prevention's (Maine CDC) Infectious Disease Epidemiology Program designed the school curriculum to educate 3<sup>rd</sup>-8<sup>th</sup> grade students in Maine. The program is evaluated annually and has been used in schools throughout Maine.

The program provides education concerning mosquito biology, viruses transmitted by mosquitoes and the diseases they can cause, and instruction on ways to decrease the risk of mosquito bites.

**GOALS:** The goals of this lesson are to:

- Increase students' ability to identify potential mosquito breeding grounds and ways to reduce potential mosquito breeding grounds around their homes
- Increase students' ability to demonstrate knowledge of methods of preventing mosquito bites

**LEARNING OBJECTIVES:** After completing this lesson, participants will have or be able to:

- Knowledge of mosquito biology and ecology
- Identification of mosquito habitats
- Knowledge of the viruses mosquitoes can carry and symptoms of the diseases these viruses cause
- Demonstrate personal protection methods

## STRATEGIES/METHODS:

- Facilitator/lecture presentation
- Hands-on group activities
- Individual activity booklet
- Class discussion
- Take-home sheet

## MATERIALS NEEDED:

- |  |  |
|--|--|
| <input type="checkbox"/> Computer  | <input type="checkbox"/> Dry erase markers       |
| <input type="checkbox"/> Projector   | <input type="checkbox"/> Dry eraser/paper towels |
| <input type="checkbox"/> "Fight the Bite!" Mosquito PowerPoint presentation with facilitator notes and vocabulary lists (approx. 20 minutes) | <input type="checkbox"/> Markers                 |
|  | <input type="checkbox"/> Buzzer (or bell)        |



## SUPPLEMENTAL ACTIVITIES AND MATERIALS:

- Small Group Activities Instructions
  - Mosquito Hotspots (Grades 3-5)
  - Mosquito BINGO (Grades 3-8)
  - Mosquito Puzzles (Grades 3-8)
  - Mosquito Jeopardy (Grades 3-5)
  - Mosquito Hot Seat (Grades 6-8)
  - Mosquito Trivia Face Off (Grades 6-8)
- Mosquito Activity Book
  - Ten Mosquito Fun Facts
  - Mosquito Vocabulary
  - Find the Hidden Mosquito Message
  - Mosquito Math Problems
  - Mosquito Inspector Checklist

## PREPARATION NEEDED:

- Gather supplemental activities
- Make copies of activity book
- Make copies of take-home sheet

## RECOMMENDED FORMAT

Maine CDC recommends presenting the “Fight the Bite!” in one-session. Changes can and should be made with the program to accommodate class schedules and needs.

- 1) Present “Fight the Bite!” PowerPoint presentation
- 2) Break into small groups for activities
  - a. Group size is suggested to be 10 students or less
  - b. Parent volunteers or teaching aides may be helpful in the small group setting
  - c. Each activity is designed to take approximately 10 minutes so students can rotate through each activity
- 3) Distribute Mosquito Activity Book and Take-Home Sheet and encourage students to share information with their families

This presentation fits nicely with the “No Ticks for ME!” education curriculum as there are common skills learned in both curricula.

## TOTAL INSTRUCTIONAL TIME:

60 minutes

## MAINE LEARNING RESULTS

Health Education	Science and Technology
A1, A3, A4, C2	E1, E4

## FEATURES OF THE PROGRAM

- Free
- Downloadable and printable presentation
- Downloadable and printable activity books
- Downloadable and printable small group activity instructions



## Introduction and Overview

### 1. Purpose of this program:

- The purpose of this program is to understand that mosquitoes can carry viruses that cause disease and how we can prevent getting those diseases.
- Mosquitoes can carry several viruses that can infect humans and animals. The three main viruses in Maine that are carried by mosquitoes are Eastern Equine Encephalitis (EEE) virus, Jamestown Canyon virus (JCV), and West Nile virus (WNV).

### 2. Sequence of the lesson:

- The program starts with a presentation on mosquitoes, what they look like and where they can be found, the viruses they can carry and the diseases that they cause, and how to prevent the diseases. Then participants are broken up into small groups to do supplemental activities.

### 3. Encourage questions and conversation:

- Encourage participants to ask questions as they come up. Encourage students to discuss this information with their parents at home in the evening.

## SLIDE NOTES

**Note:** This text accompanies a PowerPoint presentation, “Fight the Bite!” As you read the text, there will be a note about which PowerPoint slides relate to that section of text. Definitions for vocabulary words (in bold) are included at the end of this Educator Guide.

As you read the text, alternate notes will be available for certain slides, designated Grades 3-5 and Grades 6-8, to provide age-appropriate explanations of complex topics.

### Slide 2: Today we will learn:

Today we will learn:

- What do mosquitoes look like?
- Where do mosquitoes live?
- Can mosquitoes cause diseases?
- What can happen if an infected mosquito bites me?
- How can I prevent a mosquito from biting me?

  
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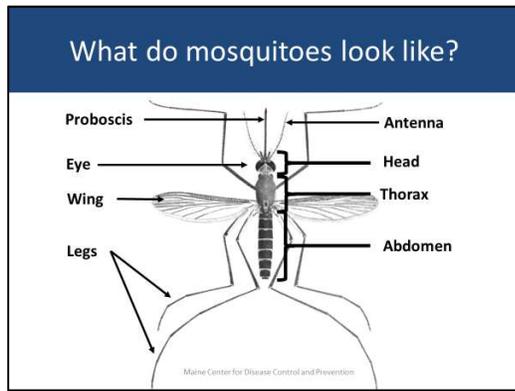
By the end of today, we will know the answers to all these questions.



## Mosquito Biology

### Slide 3: What do mosquitoes look like?

There are 45 different species of mosquitoes found in Maine, but not all bite people. A **species** is a unique group of organisms that is different from every other group of organisms.



Mosquitoes are made of a head, **thorax**, **abdomen**, **antennae**, **proboscis**, eyes, wings, and legs.

The **antennae** are long, feathery stalks on the mosquito's head that help them hear and smell.

The **thorax** is the part of the mosquito that connects the head to the abdomen and is where

the wings and legs attach. Mosquito wings beat very fast – from 300-600 times per second – which is why you can hear the buzz that mosquitoes make when they fly.

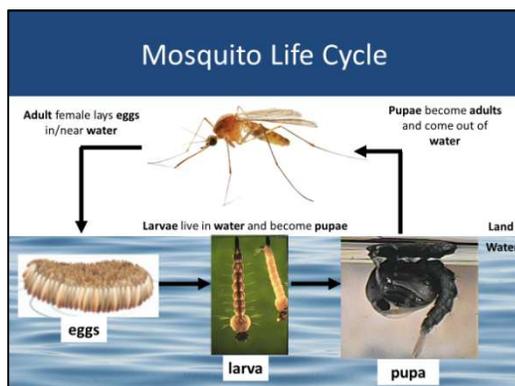
The **abdomen** is attached to the thorax and holds the mosquito's stomach and lungs, the blood, and eggs.

**Grade 3-5:** Only female mosquitoes bite and feed on blood, so they are the only ones with a **proboscis** for biting. Female mosquitoes need blood in order to lay eggs. Male mosquitoes feed only on plant nectar.

**Grade 6-8:** Only female mosquitoes bite and feed on blood, so they are the only ones with a **proboscis** for piercing skin. Female mosquitoes need the protein found in blood in order to make eggs. Male mosquitoes feed only on plant nectar.

### Slide 4: Mosquito Life Cycle

**Grade 3-5:** All mosquitoes go through 4 different stages in their life: **egg**, **larva**, **pupa**, and **adult**. The larva and pupa both need water in order to survive.



**Grade 6-8:** All mosquitoes go through 4 different stages in their life: **egg**, **larva**, **pupa**, and **adult**.

This process is called **metamorphosis** (meta=change, morph=shape). The larva and pupa both require water in order to survive.

**All grades:** When a mosquito is full of blood, she lays between 50-300 **eggs** every three days of her life. These eggs can be laid in "rafts," floating on the surface of standing water, or on ground



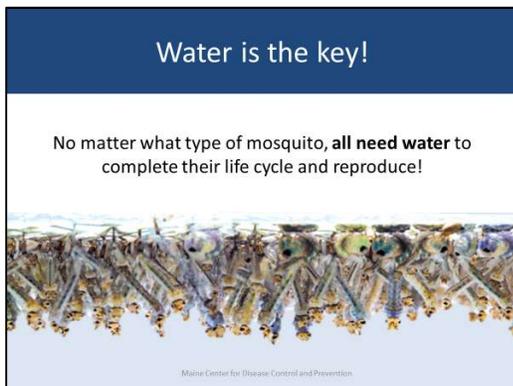
that floods regularly. If the weather is right, the egg stage lasts for 2-3 days before hatching.

**Larvae** (also called “wigglers” or “wrigglers”) hatch from eggs. They hang from the surface of the water and breathe through air tubes. The larvae filter their food (including algae, plankton, fungi, and bacteria) from the water by using thousands of tiny brushes on their mouths. The larva relies on water to be able to feed and grow. This stage lasts for about 1 week.

The next stage is the **pupa**, also called a tumbler. The pupa is partly encased in a cocoon. The purpose of the pupa stage is for the body of the larva to change into the body of the adult – this is where the legs, wings, eyes, and other parts of the adult are developing. This stage lasts for about 4 days.

After emerging, the **adult** needs to rest on the surface of the water until its wings are dry and it can fly away. This process takes about 5 minutes.

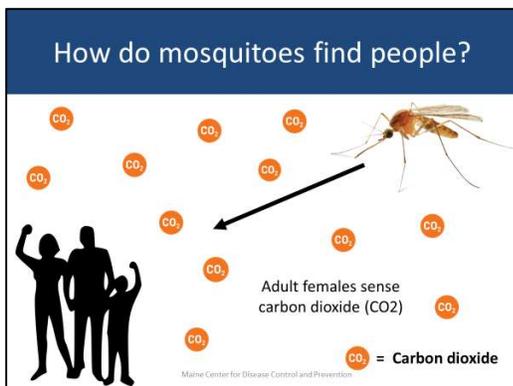
### Slide 5: Water is the key!



All mosquitoes need water to live! The larvae cannot eat and grow without it.

Can you see mosquito larvae hanging at the surface of the water? Or a few pupae curled up at the surface?

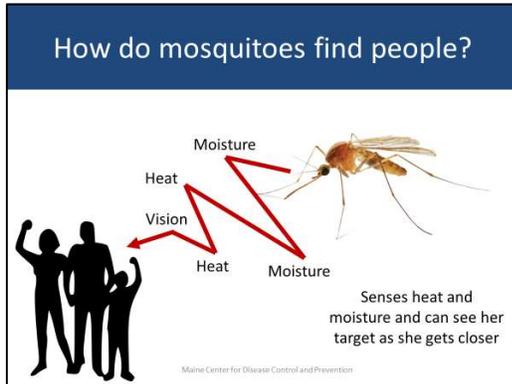
### Slide 6: How do mosquitoes find people to bite?



Mosquitoes find their **hosts** by smell and vision. A host is an animal that mosquitoes can feed on. All humans and animals breathe out **carbon dioxide (CO<sub>2</sub>)**. When a female mosquito senses carbon dioxide (from up to several hundred feet away!), she will fly toward it to find a host.



## Slide 7: How do mosquitoes find people to bite?

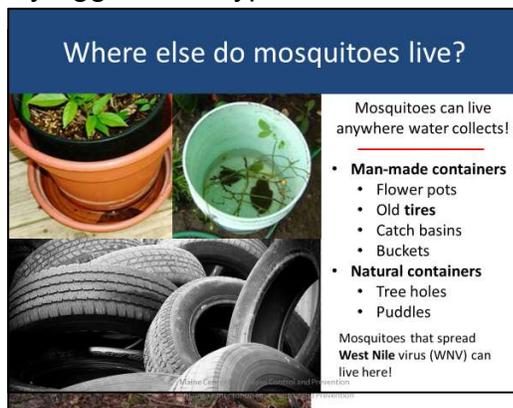


As she gets closer, the female mosquito starts to sense the heat and moisture that your body gives off. Once she is very close, she can use her vision to find a place to land.

## Mosquito Ecology

### Slide 8: Where do mosquitoes live?

Different types of mosquitoes like different types of water habitats. Mosquitoes mostly lay eggs in two types of water habitats. These are **permanent water** and **flood water**.



**Permanent water** is present for a long period of time and can support many different types of plants. Swamps, bogs, ponds, and ditches that are always full of water are good examples. Some mosquitoes prefer to lay eggs in areas like this, with clear or tea colored water and a lot of plant life.

**Flood water** areas are where water collects when it rains or when snow melts. These areas can be wet or dry depending on the weather, so

eggs laid here may need to wait for rain in order to hatch.

### Slide 9: Where else do mosquitoes live?

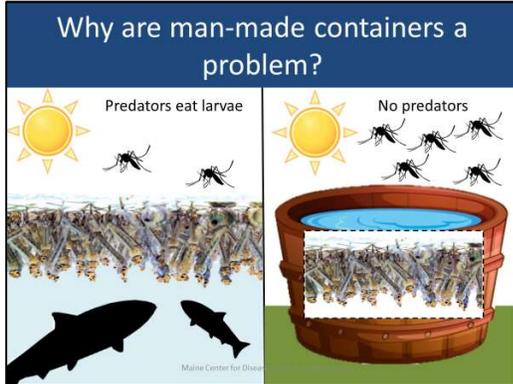
Some mosquitoes that use flood water habitats will use small containers that fill with water during rainfall. Some species use natural containers, and some will use man-made containers.

**Man-made containers** are containers made by humans that fill with water. Mosquitoes can use buckets, cans, flower pots, catch basins, pet bowls, pools, and other containers around our homes to lay eggs. Unused car tires that fill with water are the number one mosquito breeding site around the home!

Mosquitoes also like to lay eggs in **natural containers**. Holes in trees or puddles where water collects are good examples.



## Slide 10: Why are man-made containers a problem?



Under normal conditions, permanent water and flood water mosquito larvae have **predators** that will eat them, like fish, birds, and dragonflies. This helps to keep the number of adult mosquitoes under control. Man-made containers in our yards do not have any predators. This means that they can produce more adult mosquitoes than normal.

## Slide 11: Mosquito Fighting Tip #1



So, what can we do to lower the number of mosquitoes around our homes? Do you have any ideas?

One great thing is to empty the water out of any water containers outside the house! This includes gutters, flower pots, pet bowls, wading pools, buckets, and old tires. Check around your house tonight to look for any containers that could make a great home for mosquito larvae.

## Mosquito-borne diseases

### Slide 12: What mosquito-borne diseases have you heard of?



Mosquitoes can carry different germs (**Grade 6-8: pathogens**) that cause diseases. Different species of mosquitoes pass (**Grade 6-8: transmit**) different germs to humans.

Most mosquito-borne diseases occur in warm, tropical places in the world. But since mosquitoes can be found all the way from the equator to the arctic, so can their germs/pathogens.

What are some mosquito-borne diseases that you have heard of before?

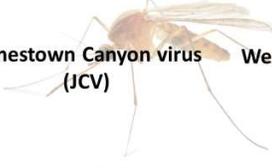


## Slide 13: What diseases are in Maine?

What diseases are in Maine?

Viruses found in Maine are:  
Eastern Equine Encephalitis virus (EEE)

Jamestown Canyon virus (JCV)      West Nile virus (WNV)



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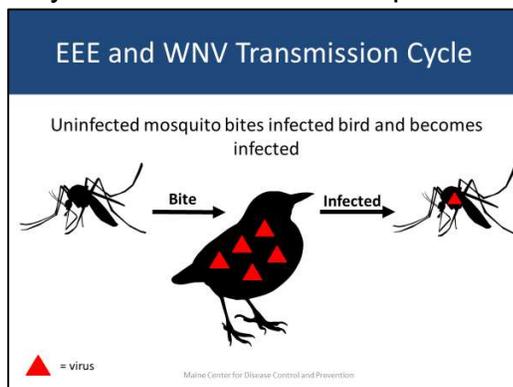
There are three mosquito-borne viruses that can infect humans and are found in Maine.

They are **Eastern Equine Encephalitis (EEE)**, **Jamestown Canyon virus (JCV)**, and **West Nile virus (WNV)**.

**Grades 6-8:** EEE is found only in the eastern portion of the US, but WNV is found throughout the entire continental US.

## Slide 14: EEE and WNV Transmission Cycle

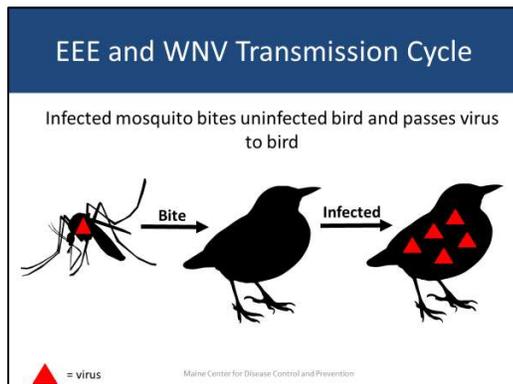
**Grades 3-5:** Mosquitoes spend their lives looking for a host. A host is an animal that they can feed on. The mosquitoes that spread EEE and WNV love to feed on birds. If the bird that they bite is infected with a germ, the mosquito can become infected too.



**Grades 6-8:** Mosquitoes spend their lives looking for a host to feed on. Some infected hosts develop high enough pathogen levels in their bloodstream to pass it to mosquitoes when they bite. These are known as **reservoir hosts**. They do not typically get sick from infection.

## Slide 15: EEE and WNV Transmission Cycle

An infected mosquito can bite a new host and pass the germ/pathogen. Now an uninfected mosquito can bite this infected host and the whole cycle starts again!



**Grades 6-8:** Birds serve as the reservoir hosts for EEE virus and WNV, while deer serve as the reservoir for JCV.

For EEE and WNV, an uninfected mosquito feeds on an infected bird and becomes infected with the virus. This infected mosquito can then feed on another uninfected bird, transmitting the virus

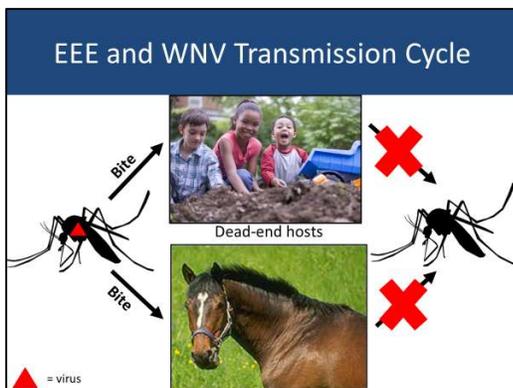


to them. The mosquito is known as a **vector** of the pathogen, since it can carry the virus from one animal to another. This cycle where a pathogen is passed from mosquito to host is called a **transmission cycle**.

This keeps the cycle of infection going and growing as more hosts become infected, known as the **amplification cycle**.

The situation is very similar with JCV, but deer are the main reservoir host, instead of birds. Infected female mosquitoes can also pass JCV directly to their eggs, known as **vertical transmission**.

## Slide 16: EEE and WNV Transmission Cycle



**Grades 3-5:** Sometimes an infected mosquito will bite a human or companion animal, like a horse, and will pass the germ to them.

These humans and animals can get sick from the germ, but the germ cannot find its way to another mosquito when it bites.

These humans and animals are known as **dead-end hosts**. This is because the germ cannot get back into another host. It hits a dead end and the cycle dies.

**Grades 6-8:** Most of the time, the transmission cycle stays between mosquitoes and their preferred hosts (birds for EEE and WNV, deer for JCV, etc).

However, sometimes a mosquito will bite an alternate host, such as a human or other companion animal – like a horse – and can infect them with the pathogen they are carrying.

These mosquitoes are known as **bridging mosquitoes**, since they cross (or bridge) the gap between reservoir hosts and other hosts for the pathogen. These alternate hosts are known as **dead-end hosts**, because they cannot transmit the pathogen to other uninfected mosquitoes. This means that humans infected with EEE, WNV, and JCV cannot infect new mosquitoes when they bite!

## Slide 17: What can happen if an infected mosquito bites me?

It usually takes about 3-18 days from the time a person is infected to when they start to feel symptoms. All three viruses in Maine may start off with symptoms that look like the flu. This means a person may get a headache and fever and may feel very tired.



**What can happen if an infected mosquito bites me?**

Encephalitis		Meningitis
Body aches		Lack of energy
Fever		Headache
<b>But MOST people infected will not have any symptoms</b>		

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These symptoms may last 1-2 weeks. The infection usually doesn't get any worse than this.

**Grade 3-5:** Sometimes more serious symptoms can develop. These can include confusion, seizures, feeling paralyzed, swelling of the brain or spinal cord, or even death. Most people who are infected will not have any symptoms.

**Grade 6-8:** Sometimes more serious symptoms can develop. These symptoms include

confusion, seizures, paralysis, coma, swelling of the brain (**encephalitis**), swelling of the brain lining and spinal cord tissues (**meningitis**), or even death. Most people who are infected will not have any symptoms.

There is no treatment for these viruses, so an infected person is given supportive care to get them through their symptoms.

## Slide 18: Travel-related mosquito-borne diseases

There are several other mosquito-borne diseases to know about when you travel outside of the United States.

These are Chikungunya, dengue, malaria, yellow fever, and Zika. They are not common in the US, but outbreaks occasionally occur.

**Travel-related mosquito-borne diseases**

Chikungunya	All show similar symptoms: <ul style="list-style-type: none"> <li>• Fever</li> <li>• Headache</li> <li>• Tiredness</li> <li>• Muscle or joint pain</li> </ul>
Dengue	
Malaria	
Yellow Fever	
Zika	



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Maine does not have the mosquitoes that carry any of these germs/pathogens.

**Grade 6-8:** Zika is particularly important because if a pregnant woman gets infected it can cause problems with her baby. One of the problems is called **microcephaly**. This means that the baby is born with a very small head.

**All grades:** It's important to take steps to prevent mosquito bites when you are traveling.

You should always take the same steps that you do at home to prevent mosquito bites. You should also try:

- staying indoors when mosquitoes are especially active
- sleeping under a mosquito net when traveling to areas where the germ/pathogen is known to be
- checking with your doctor for any medications you can take, like anti-malarial pills.



## Slide 19: Mosquito Fighting Tip #2

The best way to protect yourself from getting any of these diseases is by not getting bitten by a mosquito in the first place. Here are some tips to help protect yourself:

### Mosquito Fighting Tip #2

- **Wear protective clothing**
  - Long pants
  - Long-sleeved shirts
- **Avoid being outside dusk to dawn**
- **Use insect repellent**
  - EPA approved
  - DEET, Picaridin, IR3535, Oil of Lemon Eucalyptus



Wear long pants and long-sleeved shirts to cover up your skin.

Try to avoid being outside during the early morning and early evening. This is when the mosquitoes that can pass viruses in Maine are most active.

Use an **insect repellent** (“bug spray”) that is approved by the **EPA (Environmental Protection Agency)** for use against mosquitoes.

These include DEET, picaridin, IR3535, and Oil of Lemon Eucalyptus (natural repellent). All of these sprays can be used on your skin. Make sure that you follow the label instructions carefully and reapply according to the directions.

Permethrin can be used to treat your clothing to repel mosquitoes.

Resource: <http://cfpub.epa.gov/oppref/insect/> (EPA approved repellents)

## Slide 20: Mosquito Fighting Tip #3

### Mosquito Fighting Tip #3

- Check door and window screens for tears
  - Keep mosquitoes out of your home
- Remember to empty any water-holding containers outside.
  - **Why?**



To protect yourself at home:

Check your doors and window screens to make sure there aren't any holes or tears in them that mosquitoes could get through.

Remember, turn containers over or drill holes in them so they cannot hold water to reduce the number of mosquitoes around your home. If possible, remove unneeded containers.

If there are containers that must hold water, like bird baths or pet water bowls, empty the water out of them once a week so that mosquito larvae won't have time to complete their life cycle.

## Questions and Feedback

If you have any questions about “Fight the Bite!” or if you need additional educational materials, please contact the health educator at Maine CDC’s Infectious Disease Epidemiology Program by email at [disease.reporting@maine.gov](mailto:disease.reporting@maine.gov).

Other materials are available free of charge from Maine Center for Disease Control and Prevention. Visit this link to view and order: <https://www.maine.gov/dhhs/order>





## Fight the Bite! Vocabulary List

### Vocabulary All Grades

Vocabulary	Definition
<b>Abdomen:</b>	Part of the mosquito's body that hangs from the thorax. It holds the mosquito's stomach and lungs, the bloodmeal, and stores the female's eggs.
<b>Adult:</b>	The fully developed mature form of the mosquito.
<b>Antenna (Antennae):</b>	Long, feathery stalks on the mosquito's head, used to hear and smell.
<b>Carbon dioxide:</b>	The gas that all animals breathe out that can attract mosquitoes from several hundred feet away.
<b>Dead-end host:</b>	The virus cycle ends with this host. The host cannot transmit the virus to other mosquitoes or animals.
<b>Eastern Equine Encephalitis (EEE) virus:</b>	A virus that can be passed to humans by the bite of an infected mosquito.
<b>Egg:</b>	The first stage of the mosquito life cycle. The egg stage lasts for 2-3 days before hatching.
<b>Environmental Protection Agency (EPA):</b>	Federal agency devoted to protecting human health and the environment.
<b>Flood water:</b>	Water sources that alternate between dry and wet, like when puddles form when it rains or when snow melts.
<b>Host:</b>	The animal that a mosquito feeds on.
<b>Jamestown Canyon virus (JCV):</b>	A virus that can be passed to humans by the bite of an infected mosquito.
<b>Larva (larvae):</b>	The part of the mosquito life cycle that hatches from the egg. The larval stage lasts for about 1 week.
<b>Man-made container:</b>	Containers made by humans that fill with water. Buckets, cans, flowerpots, old tires, catch basins, pet bowls, and pools are good examples of man-made containers.



<b>Vocabulary</b>	<b>Definition</b>
<b>Natural container:</b>	Containers found in nature that can hold water. Holes in trees where branches have fallen or puddles where water collects are good examples.
<b>Pathogen:</b>	Any microorganism or virus that can cause disease.
<b>Permanent water:</b>	A water source with water levels that do not change much over time. Swamps, bogs, ponds, the calm edges of lakes and streams, and ditches that are always full of water are good examples.
<b>Predator:</b>	An animal that eats another animal.
<b>Proboscis:</b>	Long, jagged mouth part on the mosquito's head that is used to pierce the skin and suck out blood.
<b>Pupa (pupae):</b>	The non-feeding part of the mosquito life cycle during which the larva changes to the adult form. The pupa stage lasts for about 4 days.
<b>Repellent:</b>	A spray applied to skin to prevent insect bites.
<b>Species:</b>	A unique group of animals, different from other groups.
<b>Thorax:</b>	The part of the mosquito between the head and the abdomen where the wings and legs attach.
<b>West Nile virus (WNV):</b>	A virus that can be passed to humans by the bite of an infected mosquito.



## Additional Vocabulary Grades 6-8

<b>Vocabulary</b>	<b>Definition</b>
<b>Amplification cycle:</b>	The process of replicating something and increasing its production.
<b>Bridging mosquitoes:</b>	A species of mosquito that will bite many different host species, allowing the virus to cross into different species.
<b>Encephalitis:</b>	Swelling or inflammation of the brain.
<b>Meningitis:</b>	Swelling or inflammation of the brain lining and spinal cord tissues.
<b>Microcephaly:</b>	Abnormally small head associated with incomplete brain development.
<b>Metamorphosis:</b>	The process of development from immature to adult. (“meta” = change; “morph” = shape)
<b>Pathogen:</b>	Any microorganism or virus that can cause disease.
<b>Reservoir host:</b>	An organism that hosts a pathogen that is often not harmful to the host but can cause illness in other species.
<b>Transmission cycle:</b>	The cycle in which some hosts can become infected with high enough levels of pathogen to infect new mosquitoes when they bite.
<b>Transmit:</b>	The movement of a pathogen from one organism to another.
<b>Vector:</b>	A mosquito that can transmit a pathogen from one animal to another.
<b>Vertical transmission:</b>	Transmission of a pathogen from mother to child.

