MOSQUITOES

and Mosquito-Borne Diseases

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Mosquitoes are small blood-sucking insects that depend on standing water to reproduce. Female mosquitoes must feed on blood to lay eggs. They feed by sticking their mouthparts into the skin of an animal, and rapidly sucking blood. Sometimes mosquitoes carry viruses that can be transmitted to a person while the mosquito is feeding. Preventing mosquitoes from breeding and avoiding mosquito bites are the best ways to avoid getting these diseases.

Riverside County Environmental Health Vector Control monitors and provides service in the south western cities and unincorporated areas of Riverside County. This guide has been created to educate residents on mosquitoes and outline steps they can take to control mosquitoes at home.

Mosquitoes & Disease

Not only are mosquitoes annoying, but they are also vectors (transmitters) of disease. Nearly 70% of emerging threats to public health worldwide are diseases transmitted to humans from animals by mosquitoes.

Viruses such as West Nile Virus, St. Louis Encephalitis and Western Equine Encephalitis are normally found in birds but also cause illness in people each year. Most people bitten by an infected mosquito will not get sick, but approximately 20% will develop West Nile Fever. Symptoms may include headache, fever, body aches, vomiting, nausea, swollen lymph glands and skin rash on the chest, stomach and back. This virus can (though rarely) invade the brain and nervous system leading to a more severe form of illness typified by mental confusion, coma, paralysis, and in extreme cases, death.

There is no cure for West Nile Virus, but by understanding the behavior of mosquitoes and following simple mosquito-proofing and bite prevention tips, you can help protect yourself and your family by reducing your risk of contracting mosquito-transmitted diseases.
The Life Cycle of a Mosquito

The mosquito goes through four separate and distinct stages of its life cycle: egg, larva, pupa, and adult. Each of these stages can be easily recognized by their special appearance. The entire cycle can take an average of 5-7 days for most species. The adult mosquito has an average life span of 1-3 weeks.

**EGG**

Eggs are laid one at a time and they float on the surface of the water. Typically, eggs are stuck together in clusters called rafts consisting of a hundred or more eggs. Not all species make egg rafts. Some species lay their eggs separately on the water’s edge. Most eggs hatch into larvae within 48 hours.

**LARVA**

The larva (larvae - plural) live in the water and come to the surface to breathe. They shed their skin four times growing larger after each molting. Most larvae have siphon tubes for breathing and hang from the water surface. They feed on micro-organisms and organic matter in the water such as algae and bacteria.

**PUPA**

The pupa (pupae - plural) stage is a non-feeding stage as the mosquito transforms itself into a cocoon-like shell. It takes about two days for the mosquito to fully develop into an adult inside the shell. Once developed, the pupal skin splits apart and the adult mosquito emerges.

**ADULT**

After the adult mosquito fully emerges, it rests on the surface of the water for a short period of time to allow itself to dry and harden until it is ready to fly. Only female mosquitoes bite and drink blood while male mosquitoes feed on the nectar of flowers and plant juices.

The feeding female mosquito is attracted to heat, odors and carbon dioxide given off in the breath of hosts such as birds, mammals and humans.
Species of Concern

*In Southern California*

There are around 3,500 species of mosquitoes known worldwide and California is home to 53 different species. Listed are four different groups of mosquitoes found in Southern California that pose a greater concern for disease transmission.

**CULEX**

*Culex* is the most prevalent genus of mosquito in Southern California. They are persistent, have a painful bite and are most active at dusk and after dark. Some species may fly up to 10 miles. These mosquitoes primarily feed on birds but can also bite humans. They are known as major vectors for diseases such as West Nile Virus, St. Louis Encephalitis and Western Equine Encephalitis. They are often reddish brown and feed while horizontal.

**ANOPHELES**

*Anopheles* are known to be the only mosquito that can transmit malaria to humans. Although malaria is no longer common in Southern California, outbreaks can still occur when infected travelers return home after being fed upon by local mosquitoes. The larvae are often found in rivers, streams, in algae mats and cattail stands. The females are strong fliers and can fly for 5 miles or more and feed head down at a 45-degree angle.

**AEDES**

The *Aedes* mosquito were originally found in tropical and subtropical regions but now can be found on all continents. They are aggressive and painful biters. They normally feed during daylight hours. In California, the *Aedes* mosquito is responsible for transmitting canine heartworm and is often found in wooded areas where treehole cavities are common. They are distinct by being small and having black and white markings on their bodies and legs.
Species of Concern

Residential yards are the #1 source of mosquito breeding. Mosquitoes can lay eggs in anything that can hold a half inch of water for more than five days. This includes anything from neglected swimming pools and spas, clogged rain gutter, puddles in lawns to flower pot saucers, bird baths and more. Maintaining and managing or eliminating these sources of standing water regularly can help prevent breeding of mosquitoes at your home.

Use this home & garden checklist to make your activities around your home safer!

- **Trash bins**: Keep lids shut tightly and remove any water that may accumulate at the bottom.
- **Boats**: Check and remove water weekly from boat covers.
- **Fountains and bird baths**: Clean weekly.
- **Rain gutters**: Keep clear of leaves and other debris.
- **Potted plant saucers**: Don’t overwater. Drill holes in the bottom to allow for drainage.
- **Tires**: Drill holes in tire swings. Recycle used tires or store in a covered area.
- **Water bowls for pets**: Rinse and fill with fresh water daily.
- **Water troughs**: Stock with mosquito fish.
- **Leaky hoses**: Replace damaged hoses and fix leaky faucets and pipes.
- **Low areas**: Do not overwater lawns or gardens to prevent pooling of water.
- **Rain barrels**: Cover tightly with a fine mesh screen (16 mesh or smaller).
- **Chain link fence**: Cover hollow chain link fence posts with caps.
- **Drains**: Make sure that drains are not clogged by debris and flow freely.
- **Flat roofs**: Water may puddle on flat roofs during rainy seasons. Remove any standing water.
- **Lighting**: Check garden lights and eliminate water from tops of fixtures and from inside floodlights.
- **Lawn ornaments**: Check for water that may collect in lawn ornaments. Drain weekly.
- **Screens**: Install and maintain tight fitting window and door screens.
- **Rot hole in trees**: Be aware that water can collect in treeholes and dead stumps. Check with an arborist for the best way to manage water or fill cavities.
- **Water under home**: Use a sump pump to remove water.
- **Septic tanks**: Screen vent pipes with a fine mesh screen (16 mesh or smaller). Cover exposed tanks of man hole lids with plastic or a similar material and secure in place. Place several inches or more of dirt or sand over the top of the area to prevent pooling.
- **Ponds**: Stock ornamental ponds with mosquito fish. Keep ponds clear and free of excess vegetation.
- **Swimming pools and spas**: Maintain even when not in use. Remove standing water on top of covers. Report neglected pools or spas to Vector Control.
- **Containers**: Store containers upside down, cover or place in a sheltered area to prevent water build up.
- **Wheelbarrows**: Remove water that collects inside or store upside down.
Environmental Mosquito Control

Once mosquitoes reach adulthood, controlling their populations become more difficult. Removing sources of standing water where mosquitoes can lay eggs and targeting immature mosquitoes are by far the most environmentally sensitive and effective approaches for mosquito control.

Eliminating Mosquito Larvae

Larval stages of mosquitoes must have water to survive, so eliminating sources of standing water around the home removes the habitat where mosquitoes lay their eggs. Overturning buckets and other containers will reduce mosquito breeding sites around your house. In areas where water cannot be removed, mosquitoes can be managed by using biological and chemical control.

Biological Control

Mosquito fish (Gambusia affinis) is a species of small surface-feeding freshwater fish used throughout the world to control mosquito larvae. They are well adapted to live in artificial ponds and other artificial containers (fountains, etc.) and should not be released into natural areas such as lakes or rivers.

Goldfish and koi fishes may also incidentally help control larvae, but are not efficient predators of mosquitoes. Ponds that are inhabited by predatory insects such as damselflies, dragonflies and aquatic beetles often have fewer mosquito problems.

Chemical Control

Bacillus thuringiensis (Bti) and Bacillus sphaericus (Bs) are natural soil bacteria that are toxic to feeding mosquito larvae.

Methoprene is an insect juvenile growth hormone that prevents mosquitoes from successfully maturing into adults.

Both products are safe to use in ponds with fish, in horse troughs and other natural areas. They both selectivity control mosquitoes, midges and black flies.

Non-Chemical Control

Surface films are used to control mosquito pupae by preventing immature stages from obtaining oxygen from the water’s surface. These products disrupt the water’s surface tension causing mosquitoes to drown and are ideal solutions for swimming pools and manmade containers.
Eliminating Adult Mosquitoes

Adult mosquitoes are more difficult to control and require the use of non-specific products that may impact other insects. The control of adult mosquito populations may become necessary if populations are high or disease transmission is occurring in an area. Pyrethrins or their analogs are botanical-based pesticides, applied by vector control professionals as an ultra-low volume fog or into the air in the evenings or early morning hours when mosquitoes are most active.

In cases where large scale treatment of adult mosquitoes may be necessary, contact your local vector control agency. Trained technicians can treat large areas with the appropriate type and volume of insecticide.

Repelling Mosquitoes

Which repellent is right for your activity?

**DEET, IR3535®**
- Extended Hikes
- Overnight Camping

**Oil of Lemon Eucalyptus**
- Sitting at the Park
- Light Yard Work
- Stroll around Neighborhood

**PICARIDIN, DEET, IR3535®**
- Heavy Yard Work
- Barbeques
- Late Night Outdoor Activities
- Outdoor Festivals

**Some Formulations of DEET**
- Waterplay
**Repellents**

Choose a repellent containing one of the following active ingredients so you can enjoy more time outdoors knowing you are protected from biting insects. Make sure to properly read the label to ensure safe usage and protection.

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**DEET** *(diethyltoluamide)*

DEET-based repellents have provided effective, dependable protection since the 1950s.

Repellents containing DEET are available in various concentrations that repel insects equally well for the length of time they are needed.

DEET-based products are available in a wide variety of forms, including aerosol, pump, and ready-to-use products.

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<thead>
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<tbody>
<tr>
<td>Repels Ticks</td>
<td>YES</td>
</tr>
<tr>
<td>Ages for Children</td>
<td>Over 2 months</td>
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**IR3535®**

IR353®, also called Merck 3535, is registered with the EPA as a biopesticide, but has been used as a synthetic repellent in Europe for over 20 years with no significant harmful effects.

IR3535® was approved for use in the United States in 1999 and is currently available in aerosol, pump sprays and wipes.

While EPA recognizes the use of IR3535 as safe for adults and children, *be advised that it is an eye irritant.*

<table>
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<tbody>
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<td>Repels Ticks</td>
<td>YES</td>
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<tr>
<td>Ages for Children</td>
<td>Over 6 months</td>
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<table>
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<tr>
<th>Hours of Protection</th>
<th>Against Mosquitoes</th>
<th>Against Ticks</th>
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<tr>
<td>Less than 10% formula</td>
<td>1-2 hours *†</td>
<td>1-2 hours *</td>
</tr>
<tr>
<td>15-20% formula</td>
<td>2-6 hours *†</td>
<td>X</td>
</tr>
<tr>
<td>20-25% formula</td>
<td>5-8 hours *†</td>
<td>X</td>
</tr>
<tr>
<td>25-95% formula</td>
<td>6-10 hours *† for most products</td>
<td>2-4 hours * for some products</td>
</tr>
<tr>
<td>95% or more formula</td>
<td>8-10 hours *† for most products</td>
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</table>

* These protection times have been approved for product labels. These times are based on the technical information provided to the EPA by companies on the effectiveness of the product against mosquitoes and/or ticks. Time frames were consolidated for all brands with the same percentage formulas.

† Information provided by the Centers for Disease Control and Prevention.

X Indicated that a majority of repellent product in this category have not been registered for protection from ticks.
Oil of Lemon Eucalyptus/PMD

Oil of Lemon Eucalyptus is a natural plant-based repellent found in the oil of the leaves of the *Eucalyptus citidora* tree.

Repellents containing oil of lemon eucalyptus provide protection similar to that of products containing low concentrations of DEET.

These products tend to have a strong botanical smell and are available in a wide variety of formulations including pump sprays and lotions.

| Repels Mosquitoes | YES |
| Repels Ticks | YES |
| Ages for Children | Over 3 years |

### Repellents Continued...

<table>
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<th>Against Ticks</th>
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<tbody>
<tr>
<td>20% or more formula</td>
<td>2-6 hours ††</td>
<td>6 hours* for some products</td>
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**Picaridin/KBR 3023**

Picaridin is a synthetic repellent developed in the 1990s that has been commercially available in the United States since 2005. Picaridin is colorless, nearly odorless and is available in multiple formulations.

It provides long lasting, effective protection similar to that of products containing identical concentrations of DEET.

Be advised that no specific recommendations regarding the use of Picaridin on children have been issued by the manufacturers or the Centers for Disease Control (CDC).

| Repels Mosquitoes | YES |
| Repels Ticks | Maybe |
| Ages for Children | N/A |

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<td>Less than 10% formula</td>
<td>1-2 hours †</td>
<td>X</td>
</tr>
<tr>
<td>15% formula</td>
<td>2-4 hours †</td>
<td>X</td>
</tr>
</tbody>
</table>

**Avoiding Mosquito Bites: Do’s and Don’ts**

**DO:**

- Cover up! Wear pants, socks and long sleeve shirts especially in heavy brush.
- Use nets and fans over outdoor eating areas, place a net over strollers and baby carriers.
- Read labels! Choose repellent concentration rated for the activity and time you’re outdoors.

**DON’T:**

- Don’t use oil of lemon Eucalyptus/PMD on children younger than 3 yrs. Don’t use more than 30% DEET on anyone.
- Don’t use “fogger” insecticides. They contain more toxic ingredients than repellent applied to skin.
- Avoid using candles. They may not be effective. They emit fumes that may trigger respiratory problems.
Mosquitoes and Your Pets

Not only are mosquitoes vectors to humans, but they can also affect your pets. Canine (Dog) Heartworm Disease is a serious and sometimes fatal condition in dogs caused by the roundworm *Dirofilaria immitis*. These roundworms live within the dog’s heart and lungs. Heartworm also affects coyotes, cats (rarely), and is transmitted by mosquitoes, particularly the Western Tree Hole mosquito (*Aedes sierrensis*).

**BIOLOGY**

Adult heartworms are 6-12 inches long and can reduce blood flow to the point that the heart, lungs, liver and kidneys of canines are damaged. Symptoms are usually not apparent until after damage has been done. Advanced symptoms of heartworms include: rapid tiring, panting, chronic soft dry cough, listlessness, and weight loss.

Mosquitoes become infected and can transmit heartworm after feeding on an infected dog, fox, or coyote. Humans cannot develop heartworm even if bitten by an infected mosquito.

**PREVENTION**

It is usually impossible for mosquito control agencies to eliminate Tree Hole mosquitoes from a problem area because of the difficulty in locating and accessing breeding sources. Tree Hole mosquito larvae develop in the water that collects in rot holes of mature trees, old tires, cans, buckets and other containers. Tree Hole mosquitoes are most common in heavily wooded areas.

Homeowners should examine trees and tree stumps on their property for rot holes and cavities that can hold water. If holes are found, consult an arborist to determine the best way to correct the problem. Holes may be filled with sand or water absorbing gel polymers. Eliminate other breeding sources by emptying, turning upside down or throwing away containers that hold water.

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**Protect Your Pet**

- In California, dogs are at the highest risk to contract heartworm between March and August.
- Pet owners should consult with their veterinarian about testing and preventative medication for dogs, especially those that frequent the outdoors.
Water Storage Responsibility for Mosquito Control

Capturing and storing water has become increasingly important as communities face the threat of water shortages caused by drought. Mosquitoes will readily reproduce in water capture devices, increasing the risk of disease transmission to humans and animals in the area. Here are some tips for collecting water and preventing mosquito breeding.

Maintain water storage/infiltration devices installed on your property. Report any neglected devices, their location and any mosquito problems promptly to your Vector Control District.

RAIN BARRELS

- Tightly screen all openings on rain barrels with 1/16th inch mesh to prohibit mosquito entry. Check regularly and replace torn or degraded screens.
- Remove water that pools on the lid at least once a week.
- Keep gutters and downspouts clean and free of debris.

WATER TANKS (CISTERNS)

- Cisterns (above and below ground) must be tightly sealed to keep mosquitoes out.
- Cover all inlets, outlets, and vents with tight-fitting 1/16th inch mesh screening. Inspect regularly to ensure there are no cracks and seals remain intact.
- Maintain cistern accessible for periodic maintenance and inspection for mosquito breeding.

Storm Water Retention and Treatment Devices

Storm water retention/treatment devices should be designed and properly maintained to prevent mosquito breeding.

- Select and maintain proper slope for all water conveyances.
- Ensure swales, ditches, and rain gardens are maintained properly and drain completely within 3-4 days.
- Thin emergent vegetation and remove silt annually from storm water detention basins.
- Select native, low-growing vegetation.
- Avoid cattails or other invasive species such as creeping water primrose, water hyacinth and parrot feather which grow rapidly, can be difficult to maintain and, and prohibit effective mosquito control and inspection.
- Underground vaults/sumps must be cleaned out regularly. Select devices designed to drain completely.
What are They?

Insects that resemble mosquitoes

There are numerous insects that closely resemble mosquitoes but are generally not harmful to humans or pets. Many of these insects emerge in large numbers during the early spring, alarming the public. The following are insects that are often mistaken for mosquitoes.

**Midges**

Midges are small, gray colored flies that are similar in size to mosquitoes. Although midges can be a nuisance, particularly in communities around large aquatic habitats, most species do not bite or pose serious health risks. The tiny “no-see-ums”, however, can bite. The bites can be painful and burning. Some people are sensitive and experience allergic reactions depending on the person. If you are bitten and experience a reaction, contact your local health care provider.

Immature midges live in damp or submerged soils and are often an important source of food for aquatic predators. Adult midges have short lives and are weak flyers. During peak emergence, massive swarms may appear like clouds of smoke from afar, and when at rest, can cover houses, cars and other structures.

Personal protection is the best defense against biting midges; wear protective clothing such as long sleeves and pants. Avoid attracting midges by moving lights away from doorways, windows and patios and replace mercury vapor lights with yellow or sodium vapor lights.
CRANE FLIES

Crane flies are often called “mosquito hawks”. These harmless insects are much larger than mosquitoes and are not known to bite or transmit any disease to people. Crane flies are tan, brown or reddish in color with stilt like legs and slender bodies. The larvae live in moist soil, muddy waters or decomposing material.

These insects are short-lived and do not pose a health risk, but can be a nuisance when found inside homes or in large numbers. Crane flies are an important food source for birds and should be released back outside if found indoors.

BLACK FLIES

Black flies are one of the most irritating pests, residing in foothill areas. These small biting flies often appear in great numbers during the spring and summer months and have moved into urban areas with the proliferation of backyard ponds and water features.

Like mosquitoes, these insects bite humans and other mammals to obtain blood protein necessary for egg development. Locally, black flies do not transmit disease but can cause extreme discomfort, allergic reaction and irritation due to their biting habits.

Black flies breed in flowing rivers and streams, irrigation ditches and backyard water features. Control efforts are directed at the black fly larvae by interrupting water flow. Avoid bites by wearing protective clothing and using DEET based repellents, especially near the hairline and around the ears.
800 S. Sanderson Ave, Suite 200
Hemet, CA 92545
951-766-9454

For more information, visit rivcoeh.org