THE UNIVERSITY OF ARIZONA
Agriculture, Life & Veterinary Sciences & Cooperative Extension

THE UNIVERSITY OF ARIZONA
COLLEGE OF AGRICULTURE & LIFE SCIENCES
Entomology

Building Tribal Resilience Against Climate Change Impacts On Disease Vectors

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Collaborative Effort

Channah

And many many more…….

ITCA

ITEP

ARIZONA PEST MANAGEMENT CENTER

ARIZONA DEPARTMENT OF HEALTH SERVICES

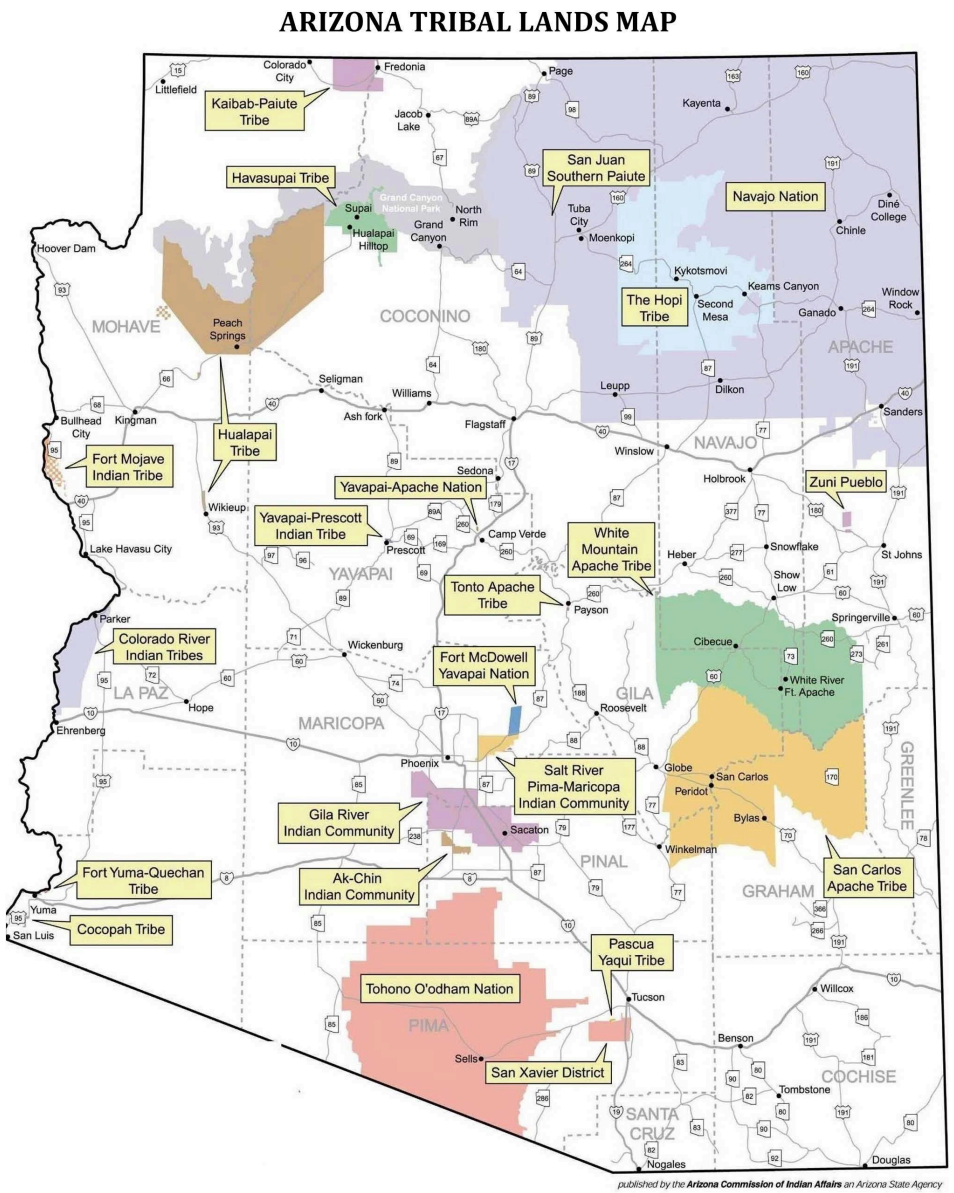
ADHS

INDIAN HEALTH SERVICE · PHS · 1955 ·

IHS

RCBH

STOP Pests in housing



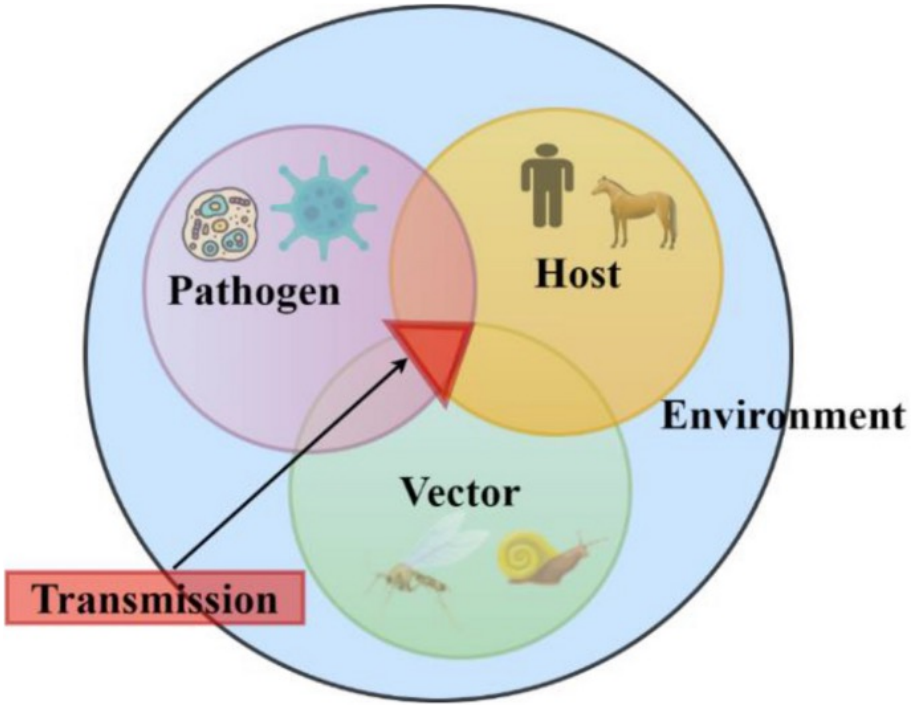
Key partners

- **Inter Tribal Council of Arizona, Inc. (ITCA):**
  - 21 Tribal Nations
  - Provide a united voice to address common issues of concerns
  - Provide technical assistance and training to tribal governments

- **Institute for Tribal Environmental Professionals (ITEP)**
  - Enhance tribal capacity in environmental and natural resource management

Vector-borne diseases

- Illnesses that are transmitted by vectors
- Vectors can carry infective pathogens
- Pathogens can be transferred from one host to another
- Three components:
  - **Pathogen**, such as viruses, bacteria, and protozoa
  - **Vector -** blooding feeding arthropods capable of transmitting pathogens between hosts, such as mosquitoes, ticks and fleas
  - **Host**



Credit: SpringLink

Climate change affects vector-borne diseases

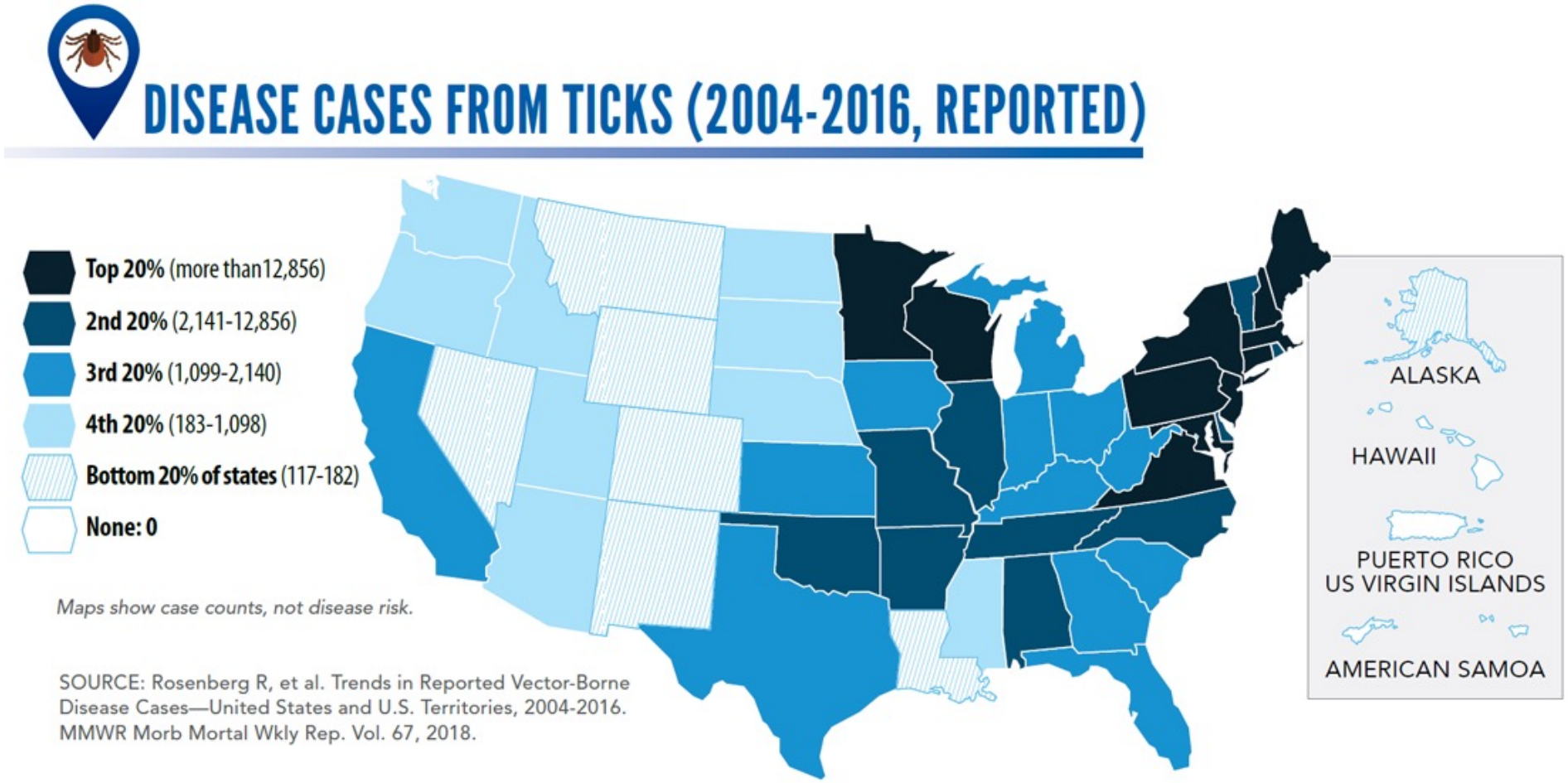
- Vectors and hosts are sensitive to climate change
- Affects vector-borne diseases by influencing:
  - ✓ Vector and host survival, reproduction, development, activity, distribution, and abundance
  - ✓ Pathogen development, replication, maintenance, and transmission
  - ✓ Geographic range of pathogens, vectors and hosts
  - ✓ Human behavior
  - ✓ Disease outbreak frequency, onset and distribution

Climate change and Health

Climate change alters the geographic and seasonal distributions and abundance of vectors – Increasing human population exposure

- Rising temperatures
  - ✓ Reproduction of vector
  - ✓ Replication of pathogen
  - ✓ Infection rates of vectors
  - ✓ Infection rates of hosts
- Changing precipitation patterns
- Higher frequency of extreme weather events

Increased risk for human disease



Vital Signs: Trends in Reported Vectorborne Disease Cases — United States and Territories, 2004–2016, https://www.cdc.gov/mmwr/volumes/67/wr/pdfs/mm6717e1-H.pdf

Rocky Mountain Spotted Fever (RMSF)

A brown dog tick bite can transmit RMSF

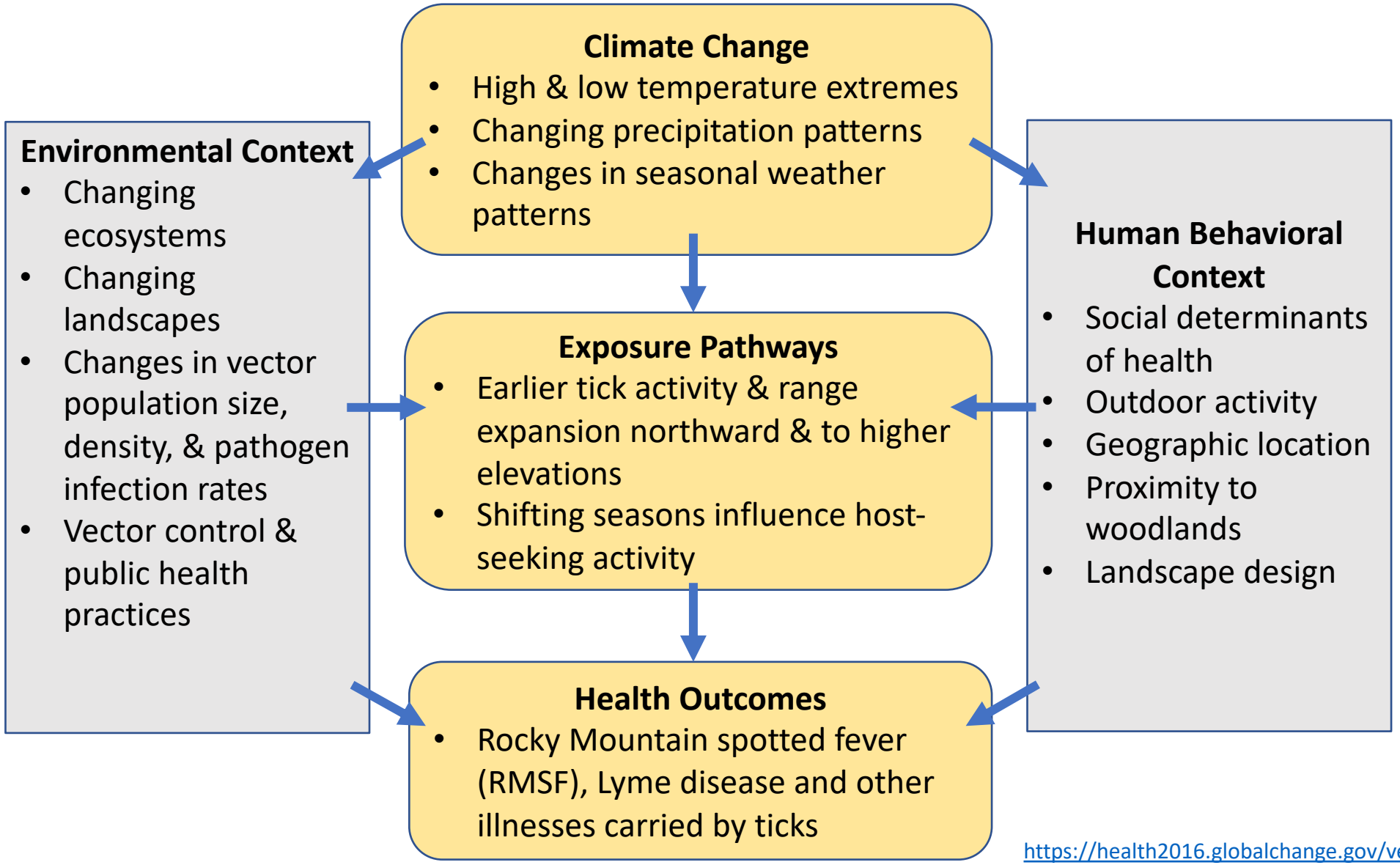
Rocky Mountain Spotted Fever (RMSF) **CAN BE DEADLY** if it is not treated soon enough.

RMSF Signs and symptoms

- Fever, headache, nausea or vomiting
- Rash, with blackened skin
- Stomach pain, muscle pain
- Lack of appetite

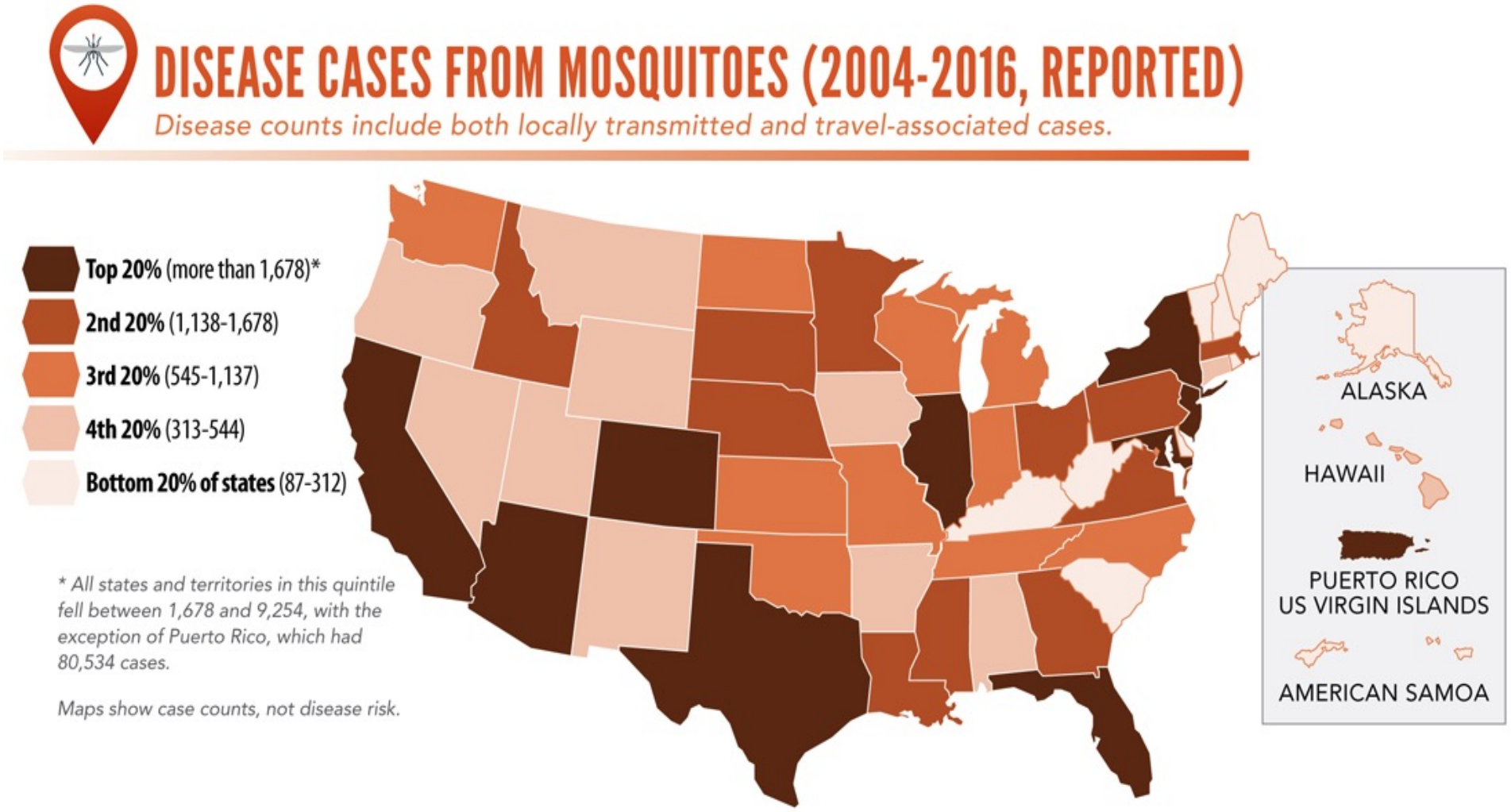
See a doctor if you have any of these symptoms

Impacts of climate change on tick-borne diseases



https://health2016.globalchange.gov/vectorborne-diseases

Increased risk for human disease



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West Nile Virus

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* West Nile virus (WNV) is spread by mosquitoes.

* Humans can be infected from a bite of a mosquito that has previously bitten an infected bird.

* Most cases are reported between May and October.

Most people have no or mild symptoms, such as:

Fever

Headache

Joint pain

Rash

Some people (especially over age 50) can have severe symptoms:

High fever

Confusion

Paralysis

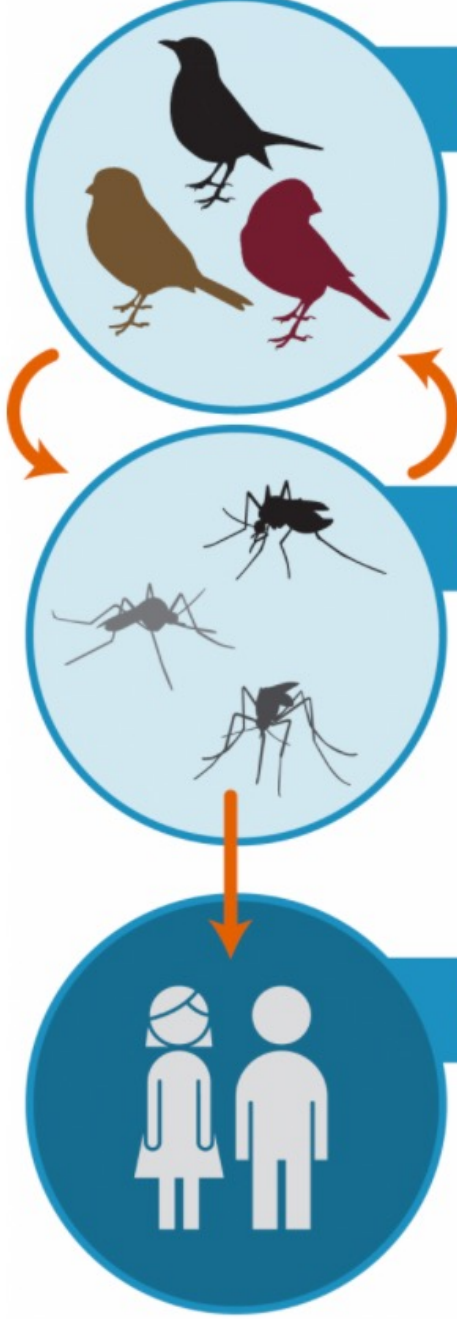
Neck stiffness

1 in 150 people will require hospitalization.

3-15% of the severe cases may be fatal.

There is no specific treatment or human vaccine for WNV.

Impacts of climate change on West Nile virus transmission



Natural Host
Birds

Warmer winters, longer frost-free season, and earlier spring arrival may influence the migration patterns and fledging survival of birds that are the natural host of WNV.
Key species: American robins, house finches, and house sparrows.

Insect Vector
Mosquitoes

Rising temperature, changing precipitation patterns, and a higher frequency of extreme weather events are likely to influence the distribution and abundance of mosquitoes that transmit WNV by altering aquatic habitat availability and mosquito and viral reproduction rates.
Key species: *Cx. Tarsalis, Cx. Quinquefasciatus.*

Incidental Host
Humans

Humans can suffer serious health consequences if infected. Changing weather patterns will likely impact human behavior and exposure to mosquitoes that carry WNV.

https://health2016.globalchange.gov/vectorborne-diseases

What we do and How we do it?

- Preventing and responding to vector-borne disease outbreaks will require:
  - all levels of surveillance
  - diagnostics
  - reporting
  - vector control
  - new tools, including vaccines

- Extent on human disease will be **limited** by the adaptive capacity of human populations

- **Integrated Pest Management (IPM) to control vectors**

What is IPM?

IPM DELIVERS

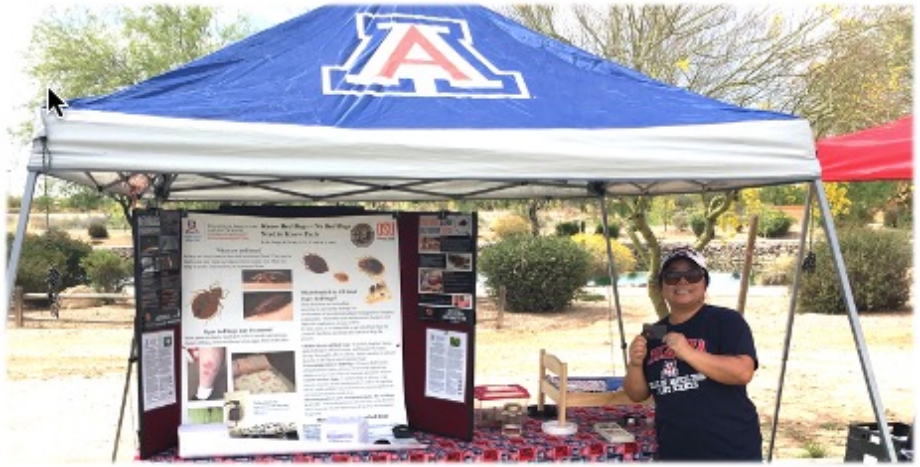
- Integrated Pest Management (IPM) is a science-based decision-making process that integrates multiple tactics to manage pests in ways that minimize risk
- IPM reduces risk by protecting:
  - Economic interests of IPM users
  - Human health
  - The environment

IPM components

- Set action thresholds
- Proper identification
- Inspection and Prevention
- Routine pest monitoring
- Plan of action
- Multiple management tactics
- Documentation and evaluation
- IPM with a focus on people: education and communication

Building Tribal Resilience against Climate Change Impacts on Disease Vectors

- Tailor a program to specific needs
- Educational trainings/workshops
- General outreach
- Broader community members involvement
- Regular communication & information sharing
- Hands-on activities and in-field investigations



Work with tribal stakeholders to address pest management/public health information needs

Reach a broad range of community members

Provide technical experts/assistance to stakeholders about a wide range of topics

Tribal Collaborators

Tribal community stakeholders

Academic Collaborators

UA Public Health IPM Team

Provide resources, funding, & information to stakeholders

Government departments & agencies

Tribal Extension Agents

Foster ongoing relationships with Tribal Extension Agents and tribal community collaborators

Li/UA

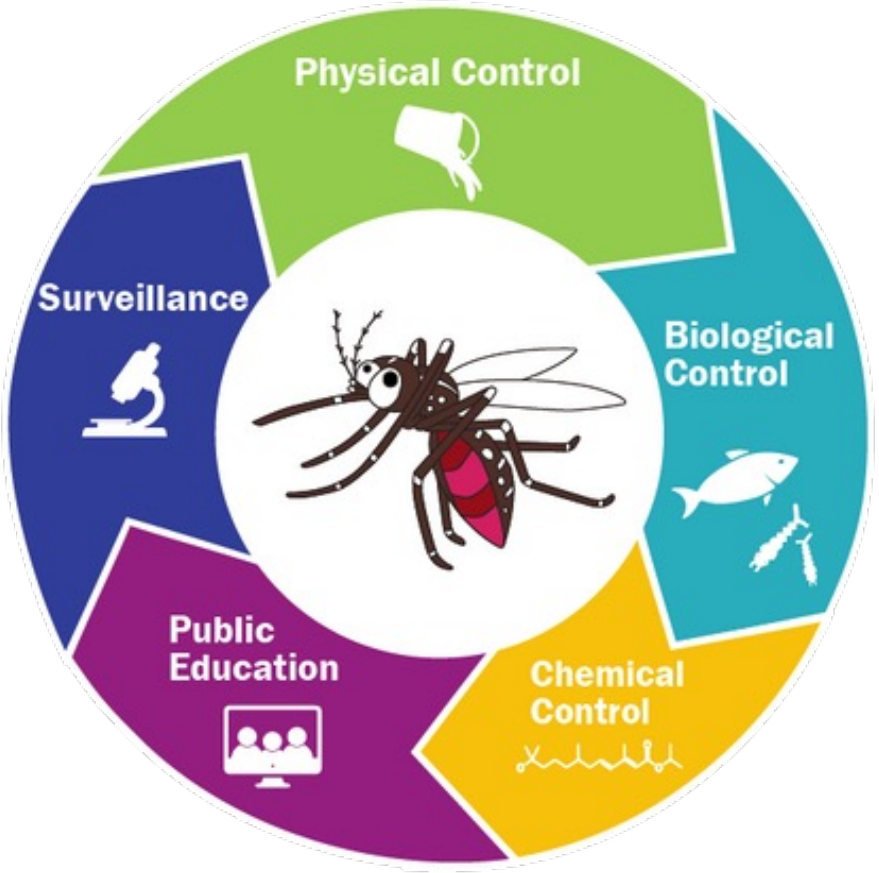
Tribal community collaborators

Include, but not limited to:

- Environmental protection officers
- Housing authority professional
- Environmental health professional
- Vector control professional
- Pest management professional
- Health care/services professional
- Veterinarian/veterinary technician
- First responder
- School personnel
- Council members

Mosquito Integrated Pest Management

- Surveillance
  - ➢ID, larvae and pupae, adults, breeding sites
- Physical control and source reduction
  - ➢ breeding sites and hiding sites
- Biological control
- Chemical control
  - ➢ Insecticide (larvicides and adulticides)
- Resistance testing
- Public education
  - ➢ use repellents, reduce conducive conditions, eliminate containers holding water, in-home prevention



WVMVCD.org

Surveillance: Larvae and Pupae

Breeding Site Surveillance

Concerns:

- Swales, tires, drainage ditches
- Water reservoirs, ponds, deserted pools

Surveillance: Adults

Oviposition trap – attracts females looking for egg-laying sites

- Identify the mosquitoes
- Different traps
- Readily available
- Price will vary

CO2 trap – attracts females looking for blood

Gravid trap – attracts females looking for egg-laying sites

BG Sentinel trap – attracts *Aedes* females looking for blood

Source Reduction

- Check property for standing water
  - Mosquitoes can breed in very small amounts of water
- Turn over containers, remove clutter
- Check storm drains and gutters, flush is needed
- Dispose of bulky waste that holds water (tires, plant trays, buckets, tarps, ice chests, children's toys, etc.
- Once per week is sufficient
- Source reduction should be done prior to applying an insecticide

Biological Control

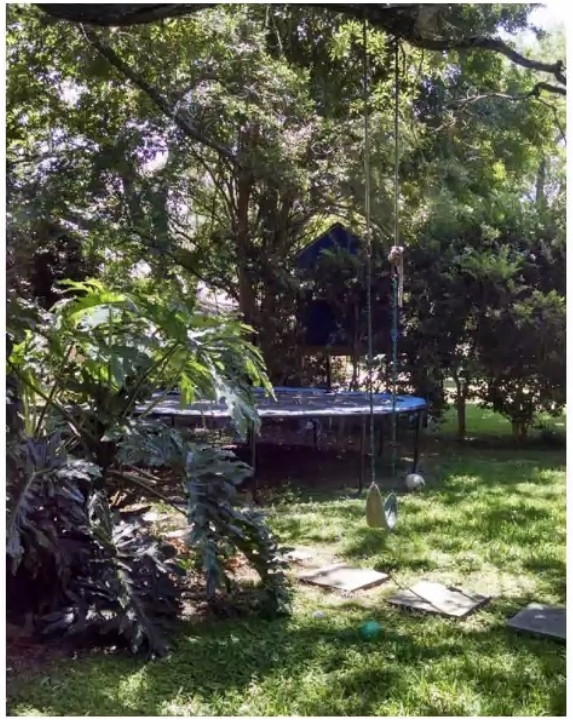
- Utilizing natural enemies (fish, copepods, turtles) to control populations of unwanted organisms
- Can be an important part of mosquito IPM

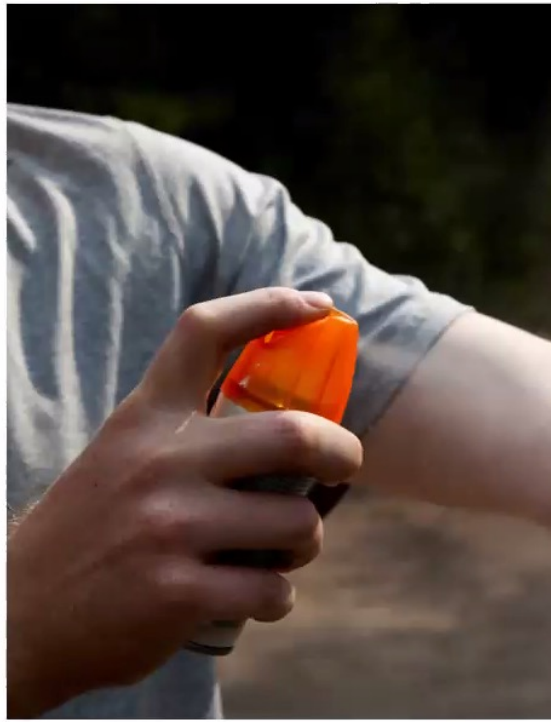
Live bearers– 75 young/female. New brood/6-8 weeks

- Broad diet; survive without larvae
- Small and easy to manipulate
- Survives in a variety of habitats
- Tolerates wide temperature range
- Reproduces quickly
- Can be used in drainage ditches, pools, large fountains or ponds

Chemical Control

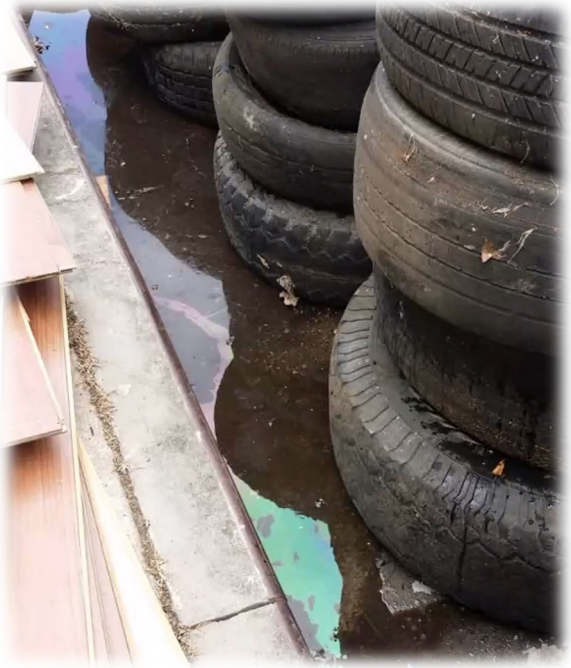
- Stop them at their source – **larvicide**
- Kill the population that remains – **adulticide**
- Erect **barriers** against the ones you miss
- Advocate personal protection as the final layer of protection – **repellents**





Types of Larvicides

- Oils
  - Suffocation – mechanical barrier at surface
  - Suffocation – oil entering the siphon blocking the passage of air
  - Poisoning due to toxic properties of the volatiles
- Monomolecular films
  - Floods the tracheal tubes with water. Breaks surface tension
- Bacterial (Bti, *B. sphaericus*, spiosid)
- Insect growth regulators (growth hormones)



WHOPES Approved Mosquito Larvicides

Larvicides WHOPES recommended	MoA	Class	Insecticide or Product
	1B	Organophosphate	Temephos*, Chlorpyrifos, Primiphos-methyl, Fenthion
	5	Spinosyns	Spinosad
	7A	Juvenile Hormone Mimics	Hydroprene, Methoprene*
	7C	Pyriproxyfen	Pyriproxyfen*
	15	Benzoylureas	Diflibenzuron, Novaluron
	11	Bacterial Larvicides	*Bt var. israeliensis, Bacillus sphaericus*

Several types of formulations & applications

Mixed formulation of an adulticide & larvicide

Methods of Adulticiding

- Space spraying
  - Aerial-based adulticiding (plane, helicopter, etc.)
  - Ground-based adulticiding (truck)
  - Backpack or hand fogger

- Barrier residual spraying
  - Residual insecticides on external resting sites (walls, vegetation)

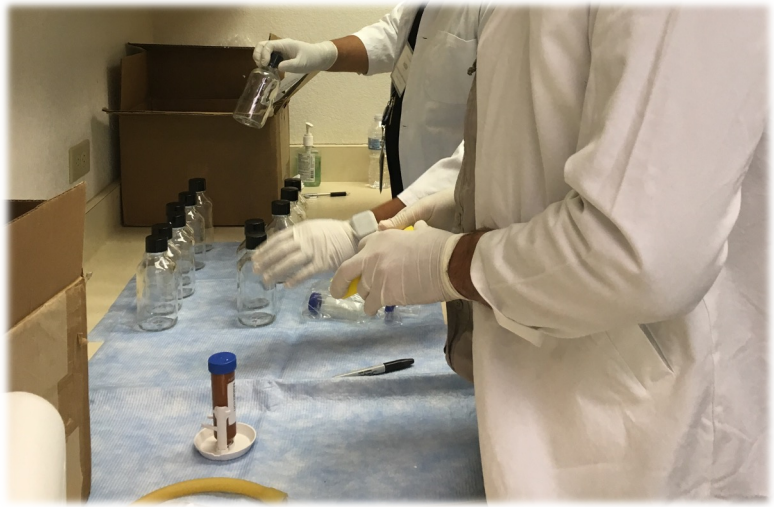
- Indoor residual spraying (IRS)
  - Residual insecticides on internal resting sites (walls, ceilings, containers, curtains, etc.)
  - Common internationally for mosquitoes resting indoors

Control: Decision Making

Variables to consider:

- Nuisance or medically important mosquitoes
- Extent of problem areas
  - Results of your inspection, adult/stage of larvae, pupae
- Vector species numbers and areas
  - Larvicide or adulticide or both
- Time of the year
- Temperature
- Wind speed
- Rainfall

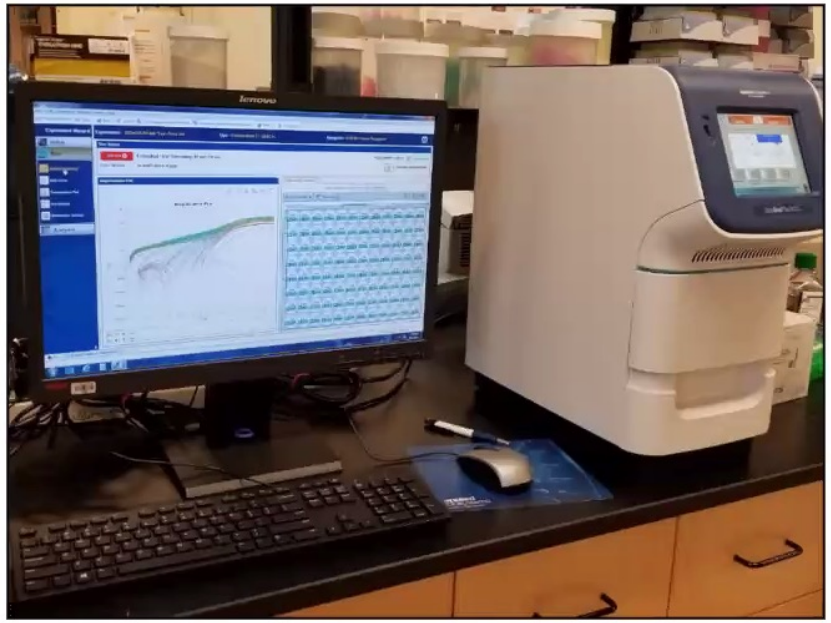
Resistance Testing



CDC Bottle Bioassay

- Bottle bioassays
- Genetic testing

Genetic testing



Education and Outreach

- Understand your audience
- Traditional and social media platforms
- Target the message to each group
- Data based program
  - Collect information to better understand and target your audience
- Communicate with your staff
- Don’t miss an opportunity to talk about the importance of vector and pest management

Mosquito IPM “toolbox”.
Photo: Theodore Puetz, AK-Chin EPO

Mosquito ID

Mosquito Surveillance

In-Home Prevention

- Install or repair and use window and door screens
- Do not leave doors propped open
- Use air conditioning when possible
- Kill mosquitoes inside your home
- When using insecticides, always follow label directions. Only using insecticide will not keep your home free of mosquitoes
- Mosquitoes rest in dark, humid places like under the sink, in closets, under furniture, or in the laundry room

When possible, stay inside between dusk and dawn, when mosquitoes are most active.

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Fix broken screens in windows and doors.

Empty and scrub, toss or cover items that can hold water to stop mosquitoes from breeding.

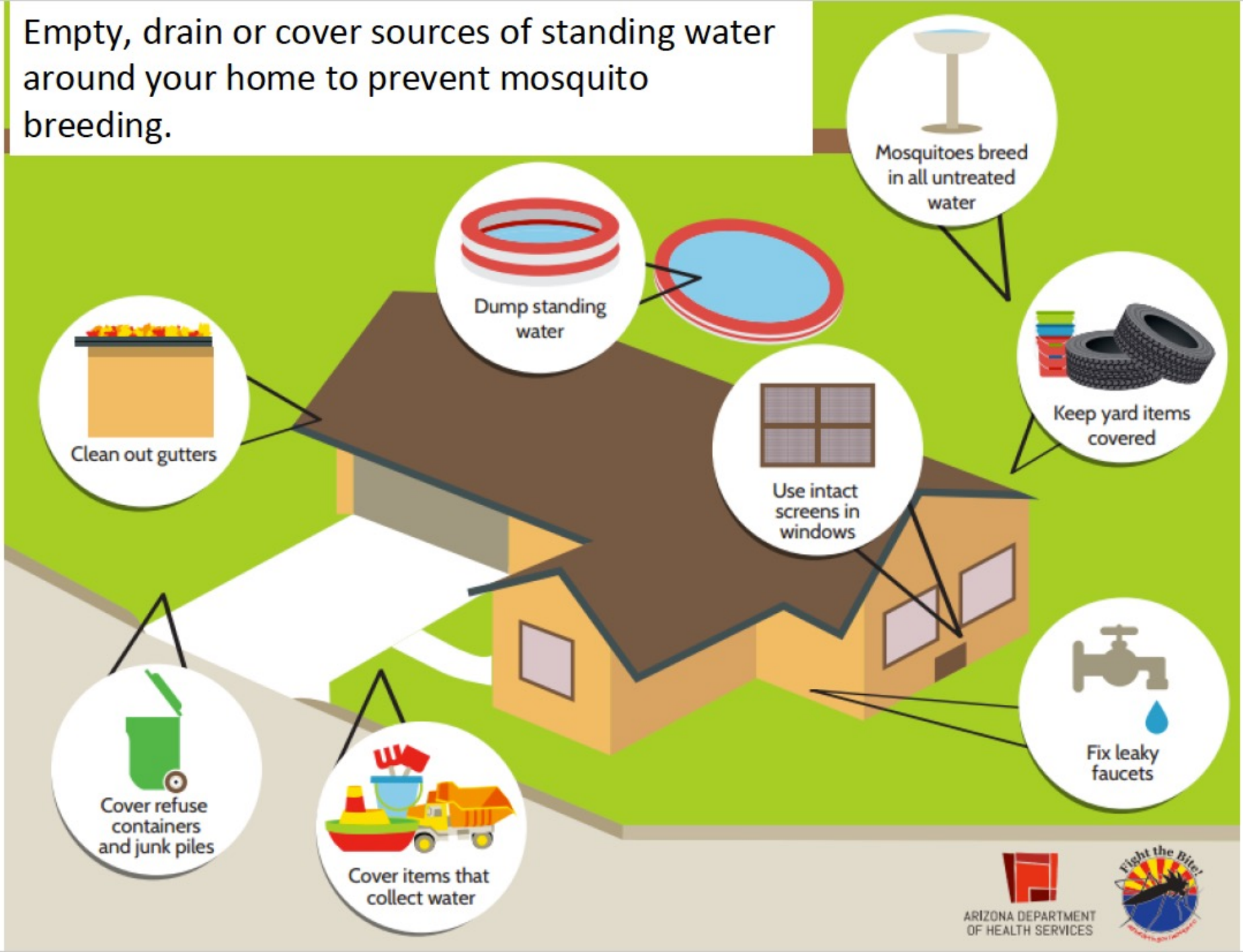
Wear clothing that covers your arms and legs.

Use EPA-registered insect repellent* on exposed skin and clothes. Follow label instructions.

*With one of the following active ingredients: DEET, picaridin, IR3535, oil of lemon eucalyptus, PMD, 2-undecanone.

Nootkatone, a new active ingredient

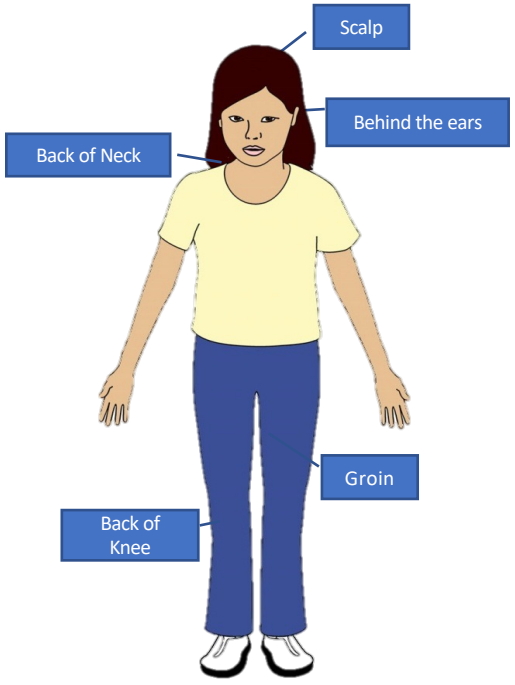
Empty, drain or cover sources of standing water around your home to prevent mosquito breeding.



Tick Integrated Pest Management

- Use personal repellent
- Check for ticks
- Remove ticks immediately if found
- Reduce yard clutter
- Apply tick collar or topical pesticide on dogs
- Use environmental pesticide (properly) if there is a tick infestation

How to find ticks

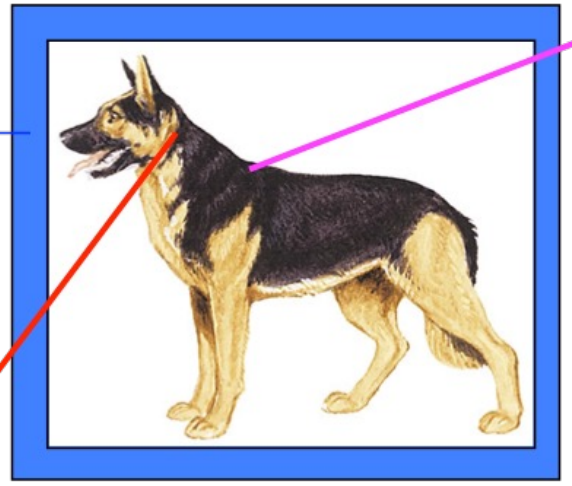


CHECK yourself, your children and your dogs daily

Tick ID & Management

Control of Ticks on Dogs

Use of sprays, dips, or dusts

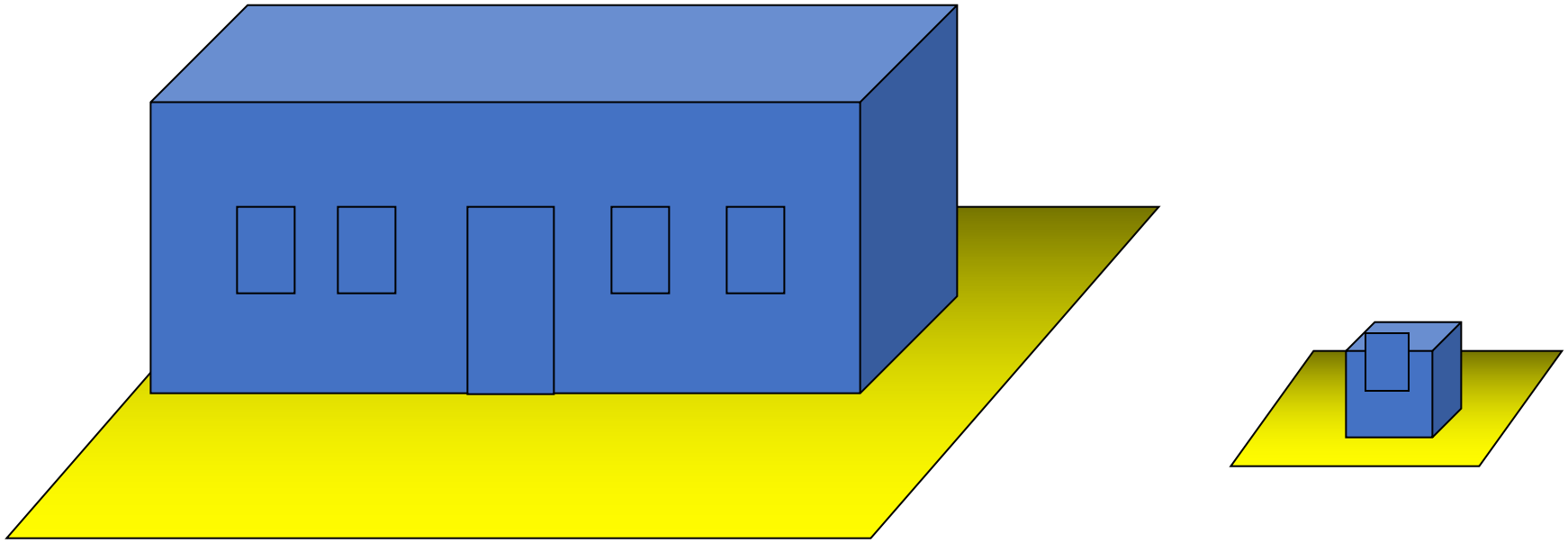


Topicals
Spot-on treatment

Tick collars

Reduction in dog numbers (spay/neuter)

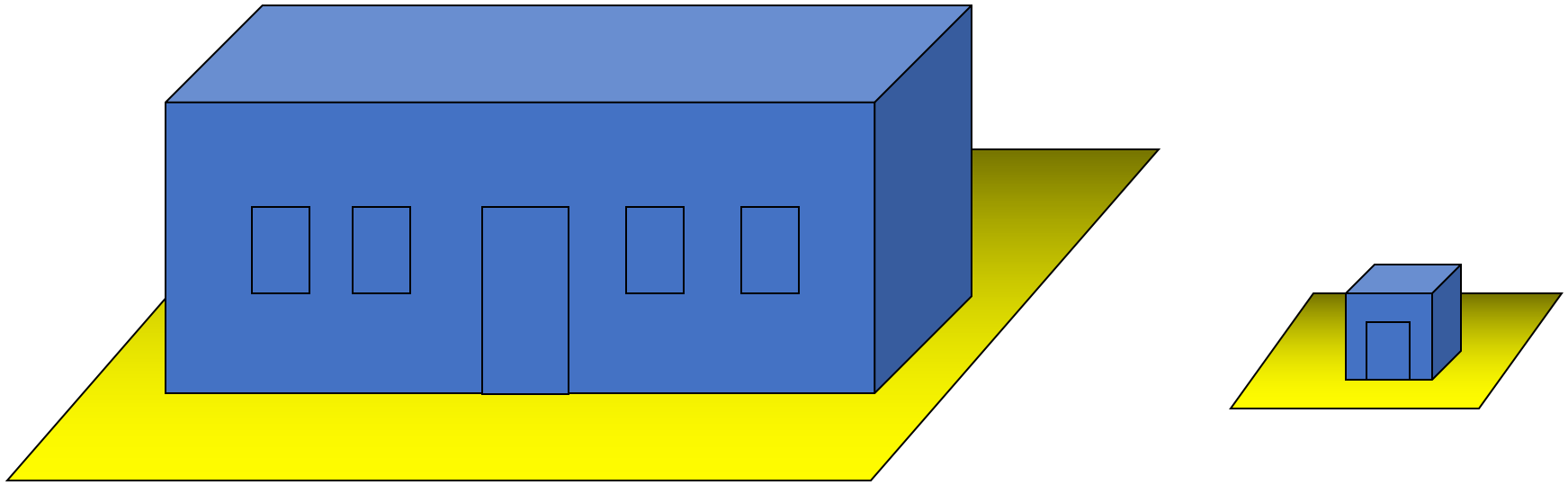
Control of ticks around houses on piers



Area to treat (under house and 6-10 feet beyond edge of house)

Also treat under and around dog houses, porches, decks, or other shady places that dogs lay regularly

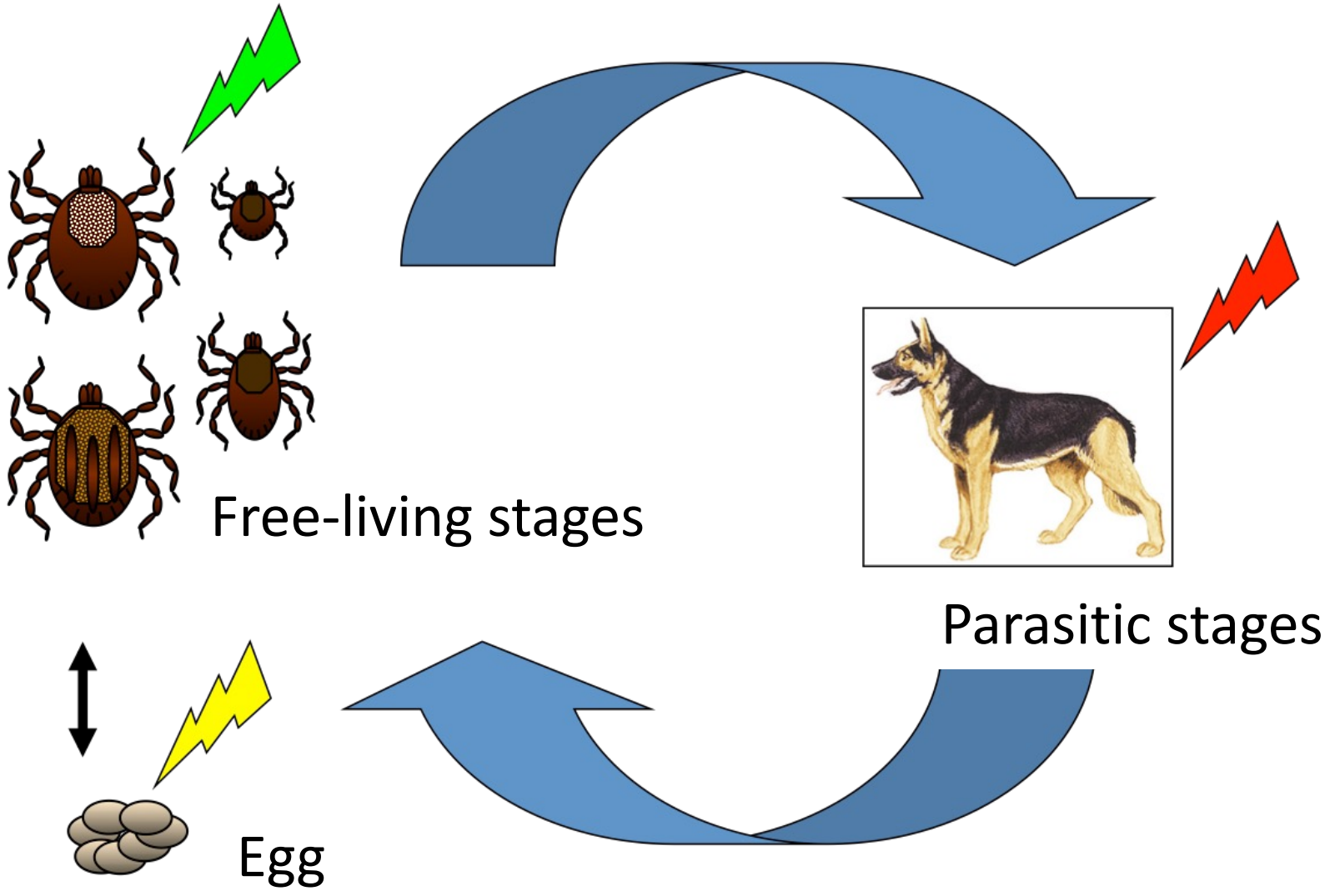
Control of ticks around houses on slabs



Area to treat (band 6-10 feet beyond edge of house)

Also treat under and around dog houses, porches, decks, or other shady places that dogs lay regularly

Effective Control Targets All Life Stages



Mobile clinics

Emergency Preparedness and Resilience Workshops

ITCA Bureau of Indian Affairs (BIA) Training. January 29-30, 2020

ITCA Bureau of Indian Affairs (BIA) Trainings.
January 29-30, 2020
May 25-26, 2021

October 18-19, 2022

Vector-borne diseases, climate change & IPM

Maximize impacts through collaboration

National IPM Training for Tribal Communities, San Diego, CA. June 26-28, 2019.

September 20-22, 2022

National IPM Training for Tribal Communities, San Diego, CA. June 26-28, 2019

Thank you!

United States Department of Agriculture
National Institute of Food and Agriculture

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