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Center for  
**VECTOR BIOLOGY**  
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# Ticks and Lyme disease in NJ

## Kingstone Greenways association

Alvaro Toledo PhD  
Assistant Professor at the Department of Entomology.  
Rutgers University

# Outline

## Ticks

- What are ticks?
- The life of a tick
- How do ticks feed?
- How to remove a tick
- What tick species do we commonly encounter in NJ?

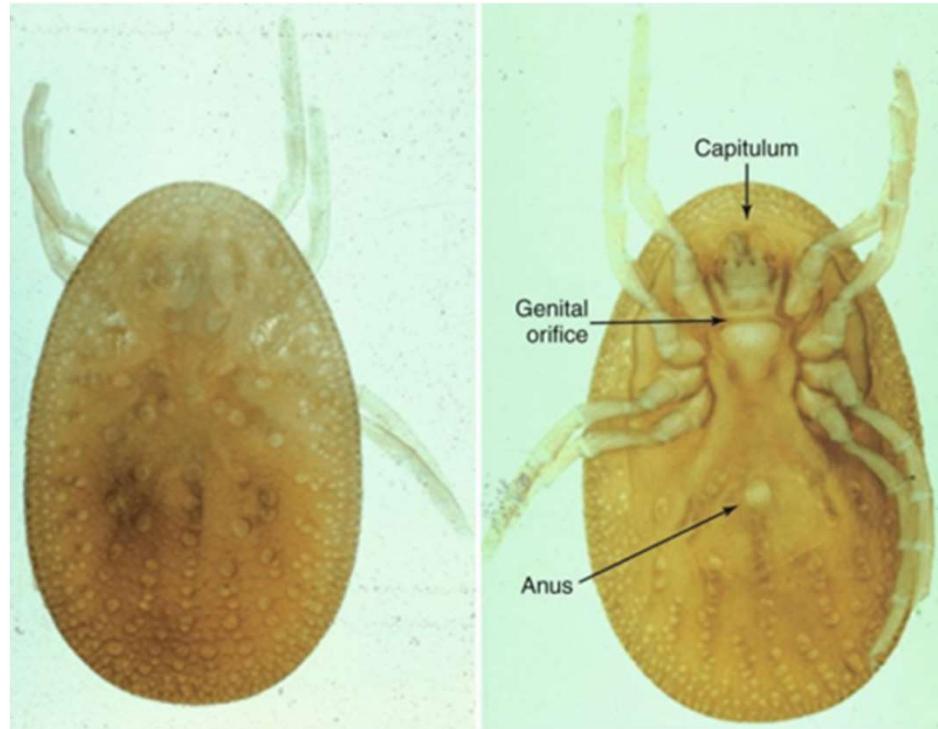
## Lyme disease in NJ

- Ticks and tick-borne pathogens in NJ
- Causative agent of Lyme disease
- Signs and symptoms of LD
- Diagnosis
- Treatment

# What are ticks?

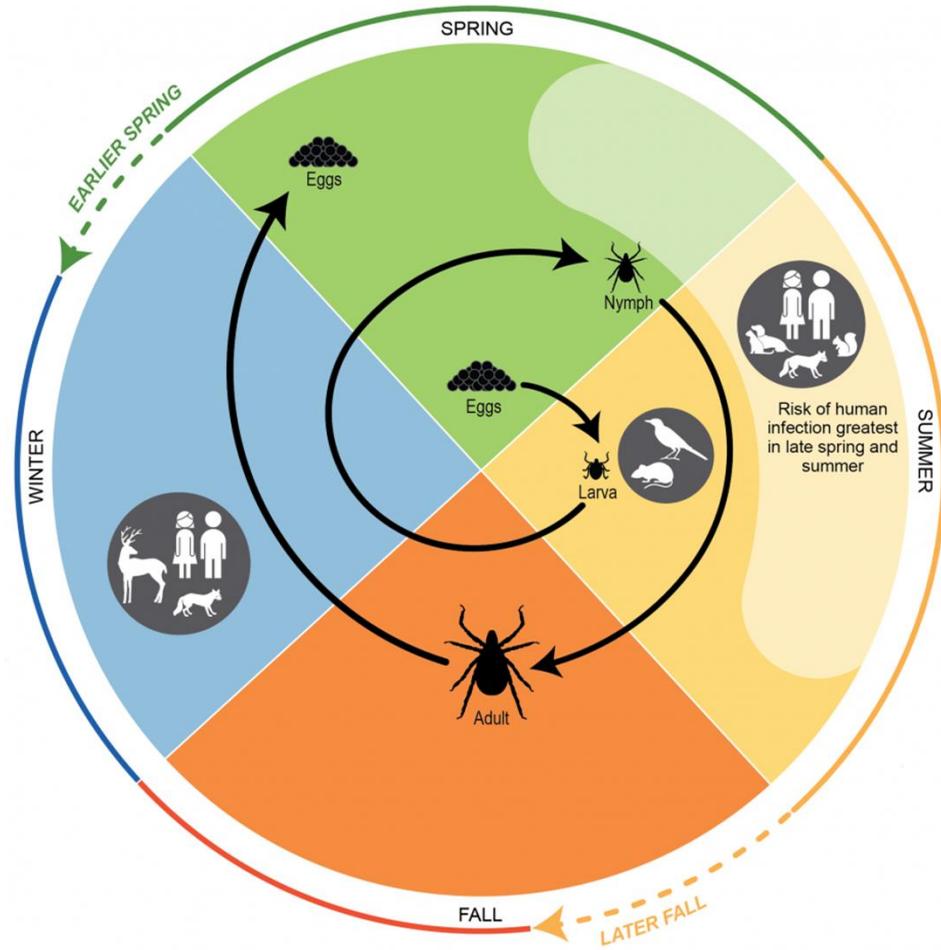
Ticks are small arachnids, part of the order Parasitiformes. Along with mites, they constitute the subclass Acari. Ticks are ectoparasites (external parasites), living by feeding on the blood of mammals, birds, and sometimes reptiles and amphibians

**900 species**

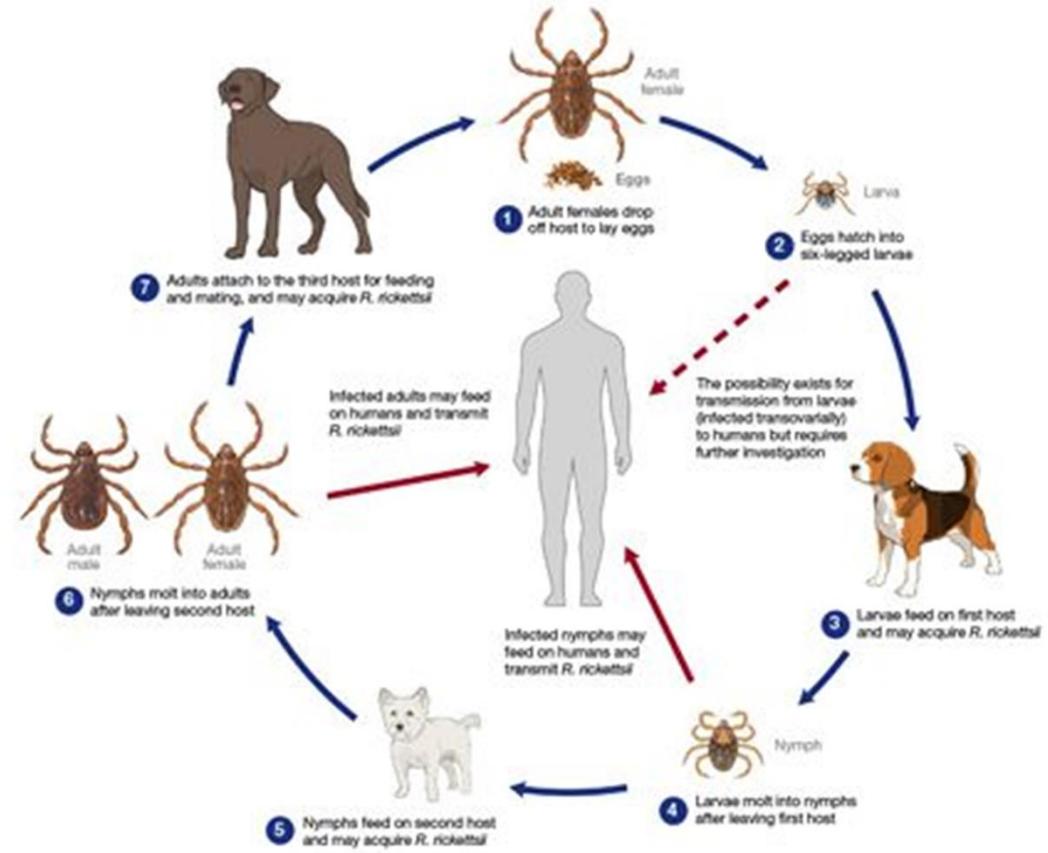


Kingdom: Animalia  
Phylum: Arthropoda  
Class: Arachnida  
Subclass: Acari  
Superorder:  
Parasitiformes  
Order: Ixodida  
Families  
**Ixodidae – hard ticks**  
Argasidae – soft ticks  
Nuttalliellidae – one  
species

# The life of a tick



Life cycle of *Rhipicephalus sanguineus* and the transmission of *Rickettsia rickettsii* (the causative agent of Rocky Mountain Spotted Fever)



Images are not drawn to scale. *R. sanguineus* can maintain *R. rickettsii* between life stages. Humans, as well as dogs, may become infected when bitten by a tick infected with *R. rickettsii*.

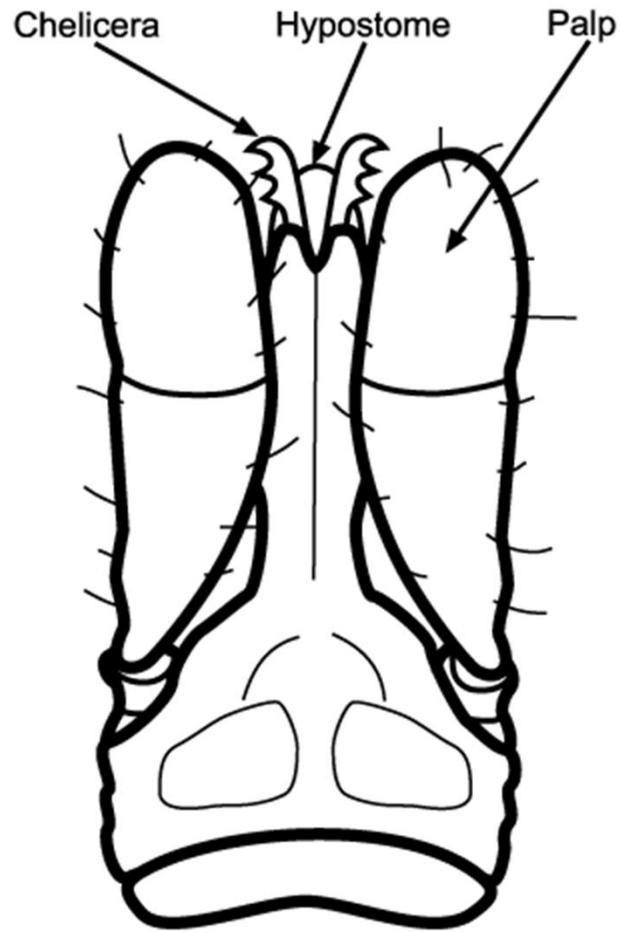


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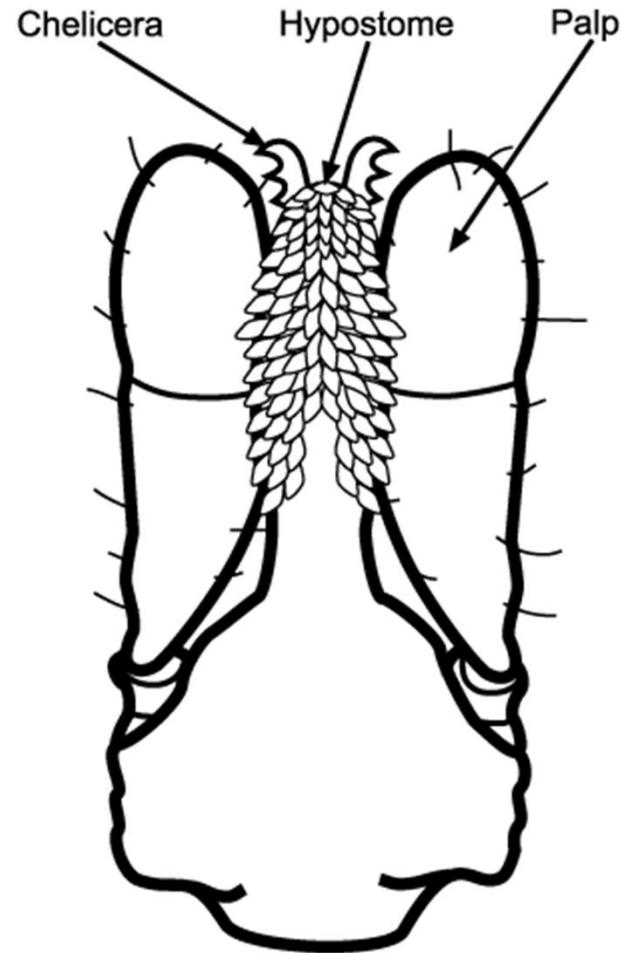
# How do ticks feed?

Top view



Base of Capitulum

Bottom view



Base of Capitulum



# How to remove a tick

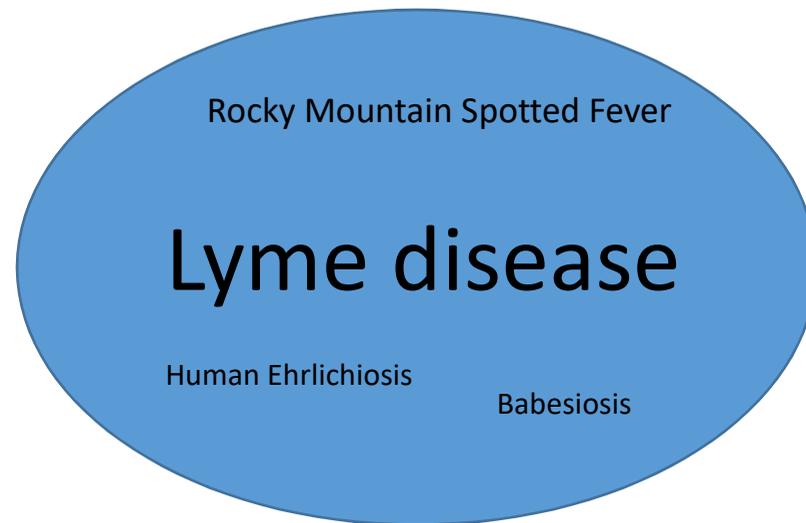


# Ticks in NJ

## Ticks



## Diseases



# What tick species do we commonly encounter in NJ?

*Anaplasma phagocytophilum* (HGA)



*Borrelia burgdorferi* (Lyme disease)

*Borrelia miyamotoi* (RF borreliosis)

*Babesia microti* (Human babesiosis)



*Rickettsia rickettsia* (RMSF)

Powasan virus



*Francisella tularensis* (tularemia)

*Rickettsia rickettsia* (RMSF)



*Ehrlichia chaffeensis*

*Ehrlichia ewingii*

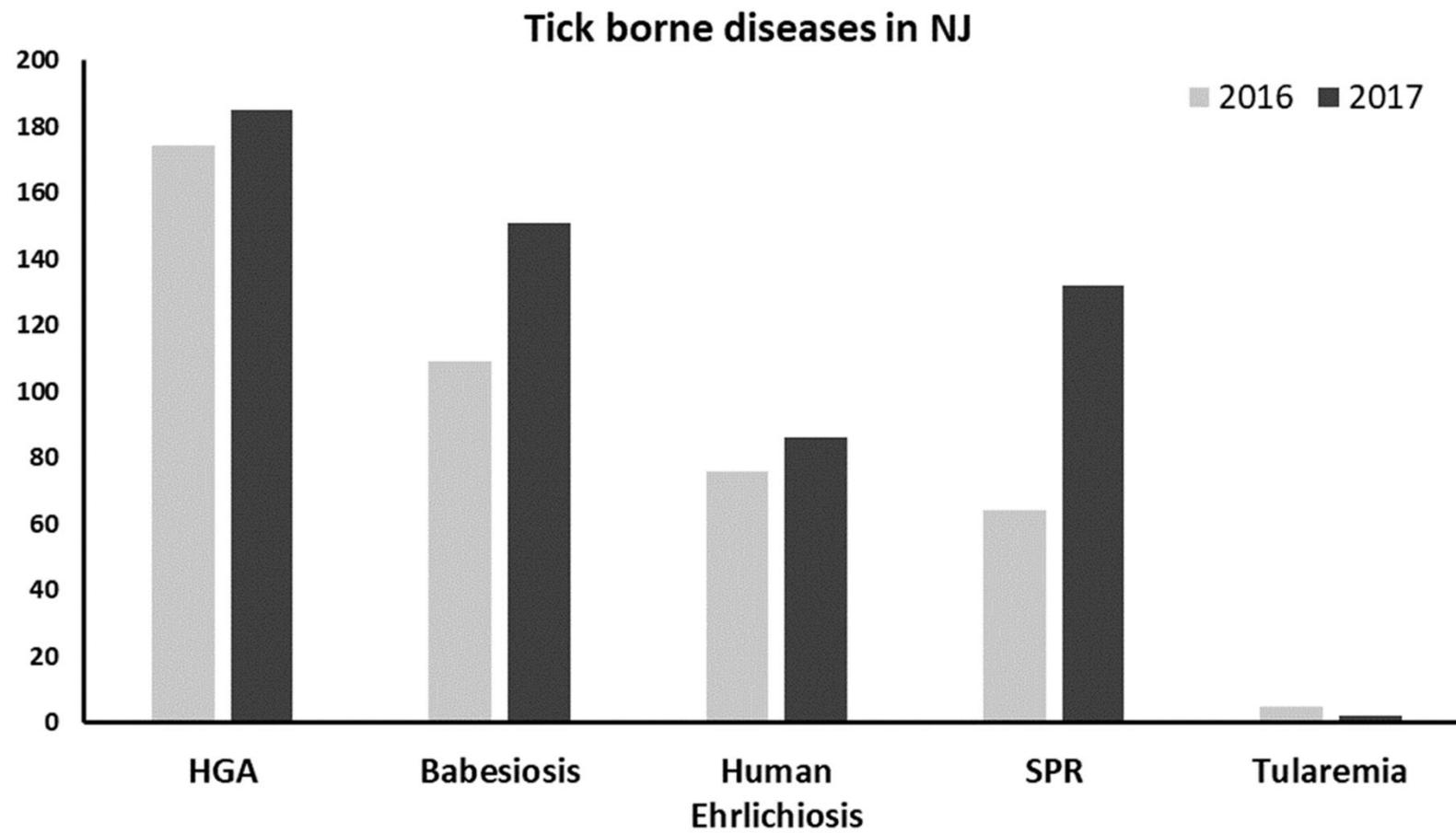
} Human Ehrlichiosis

*Francisella tularensis* (tularemia)

Heartland virus

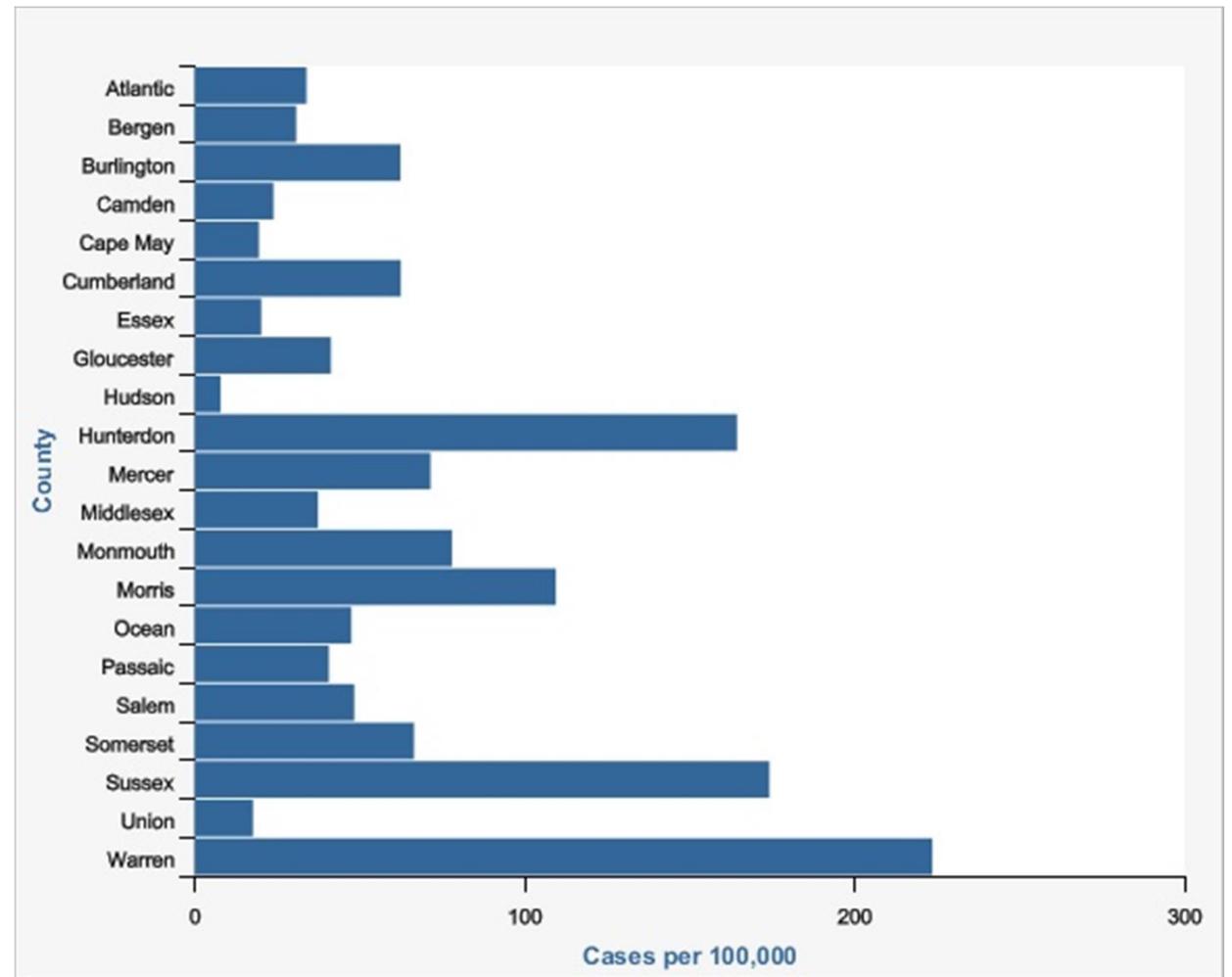
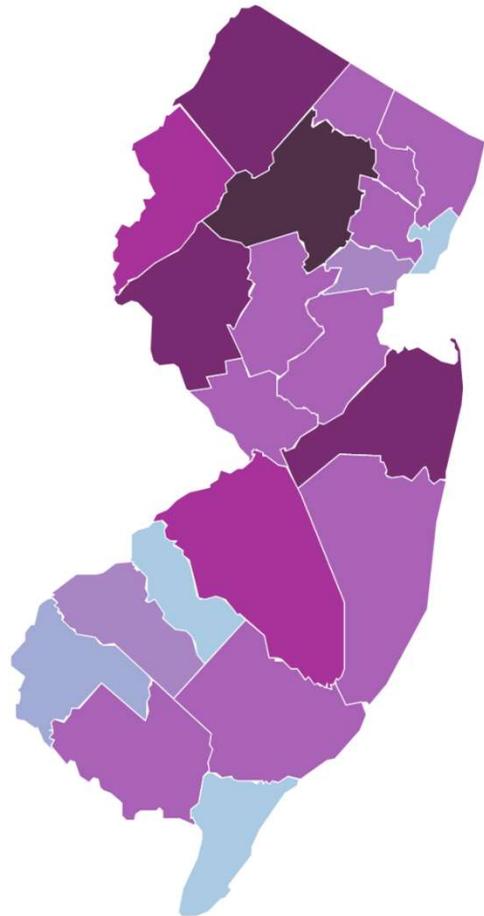
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# Tick-borne diseases in NJ

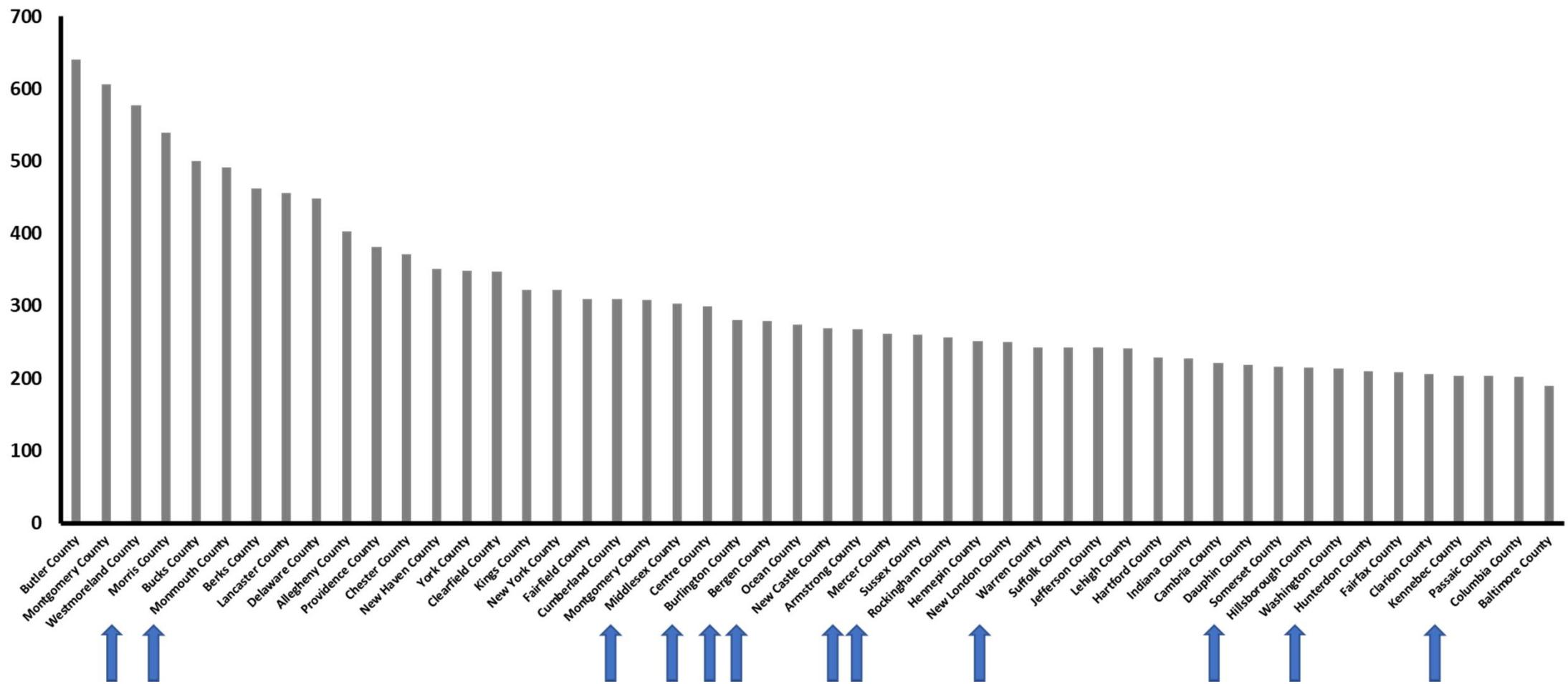


# Lyme disease in NJ

**NEW JERSEY LYME DISEASE  
THROUGH THE YEARS**



# 12 out of the top 50 counties in the USA with most LD cases are in NJ



Reported Cases of Lyme Disease -- United States, 2001



1 dot placed randomly within county of residence for each reported case

Reported Cases of Lyme Disease -- United States, 2013



1 dot placed randomly within county of residence for each confirmed case

There are 30,000 cases of Lyme disease reported annually. Preliminary results from three different evaluation methods suggest that the number of people diagnosed with Lyme disease each year in the United States is around 300,000. (CDC)

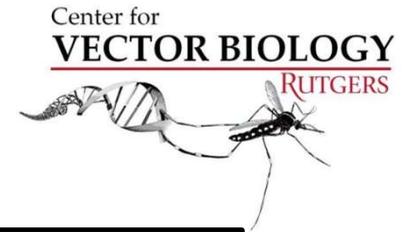
# Outline

- *B. burgdorferi*: The agent of Lyme disease
- Life cycle of *B. burgdorferi*
- Transmission of Lyme disease
- Can I get Lyme disease ....?
- Clinical manifestations
- Lyme disease in children
- Diagnose of Lyme disease
- Chronic Lyme disease



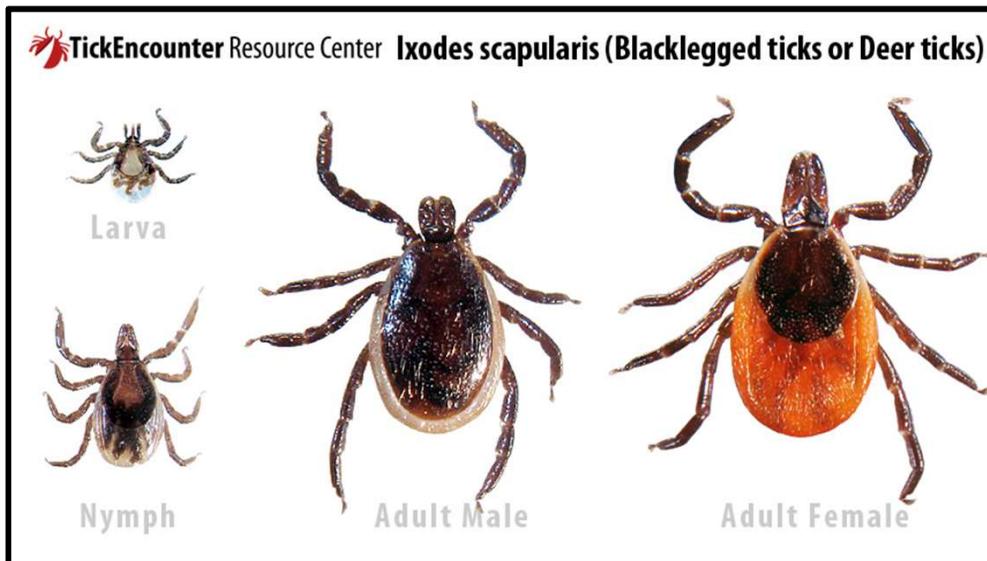
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# *B. burgdorferi*: The agent of Lyme disease

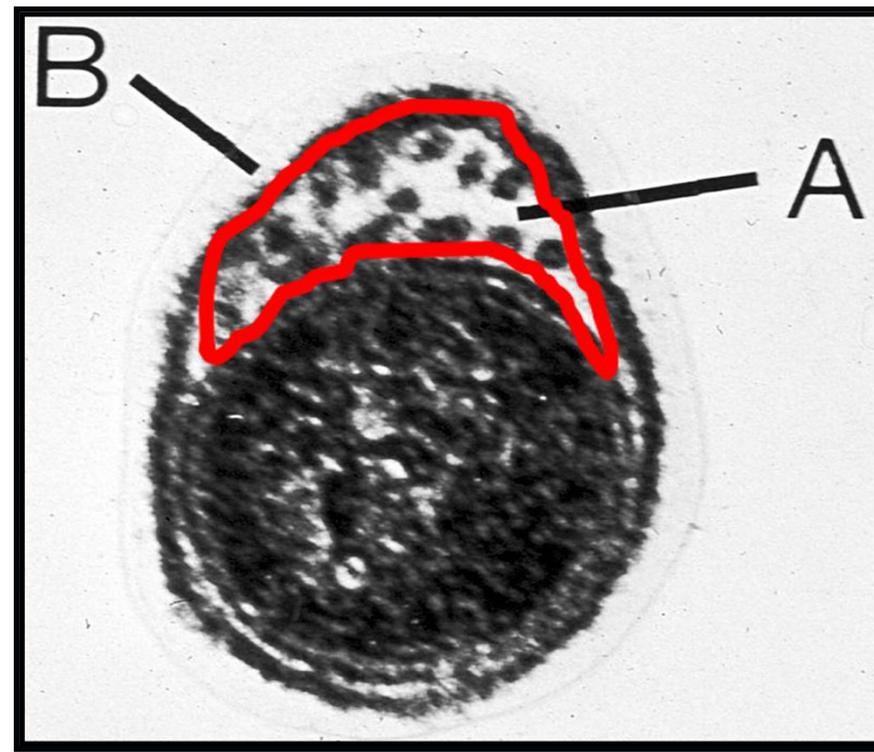
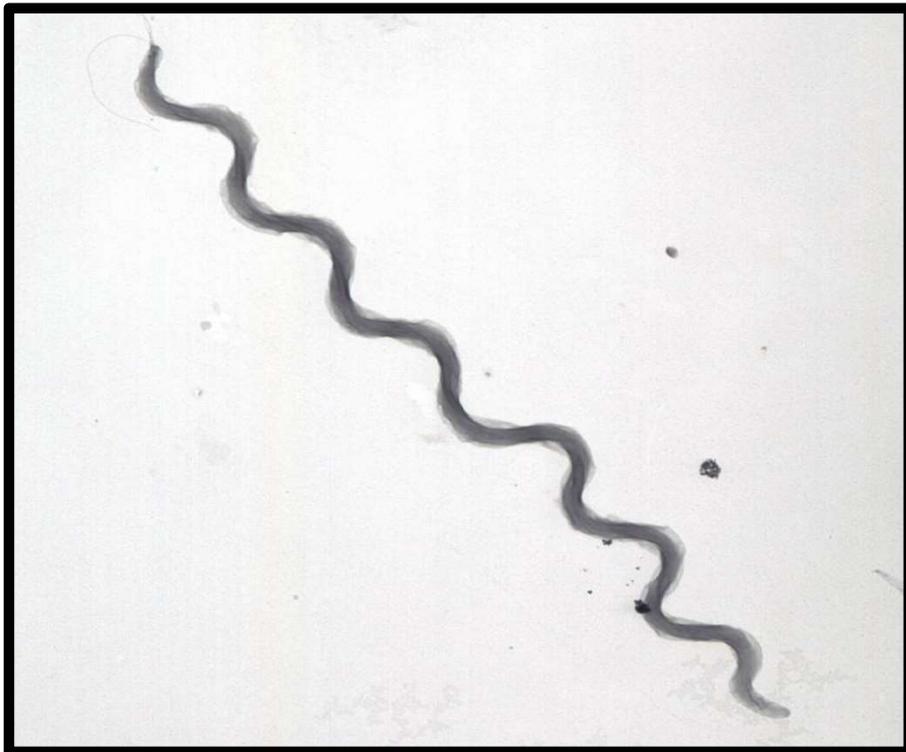


## Characteristics:

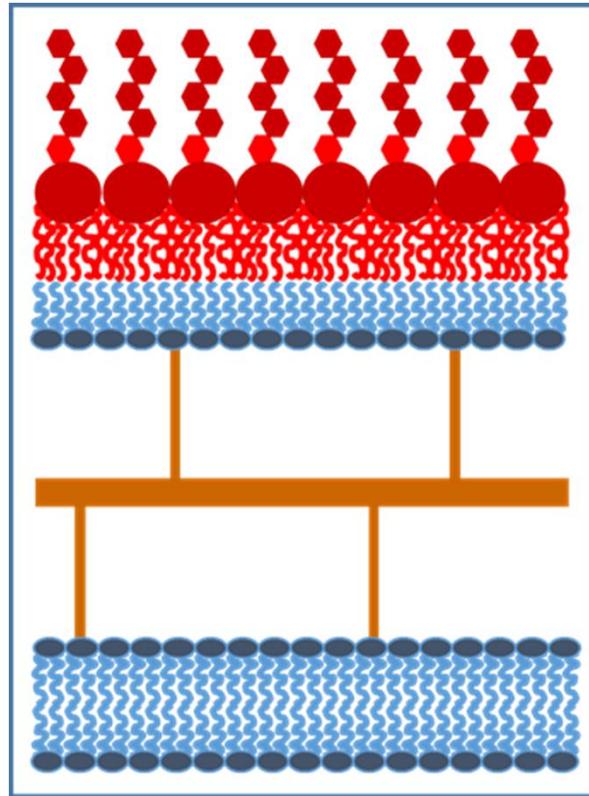
- Gram negative
- Spirochete: flat wave morphology
- Tick-borne pathogen: transmitted by the complex *I. ricinus*
- LD is the most prevalent tick borne disease in the northern hemisphere.



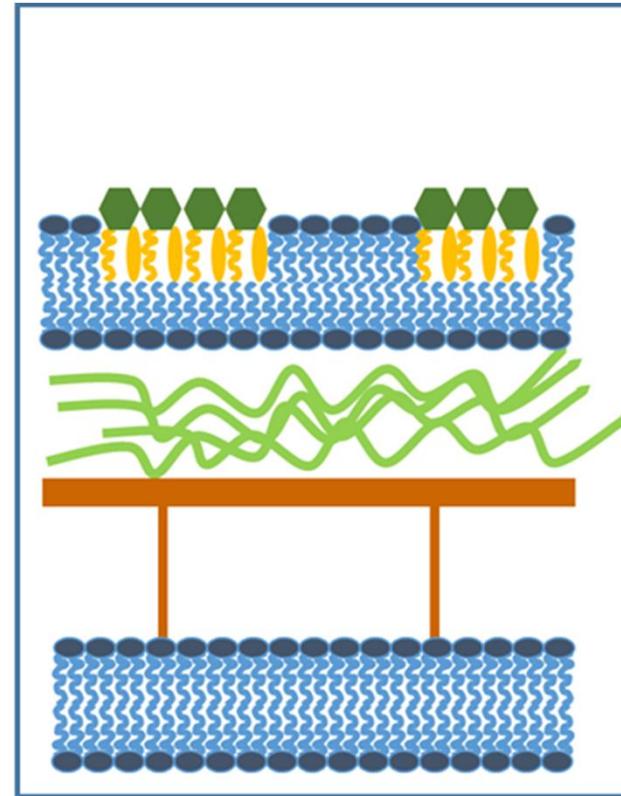
# *B. burgdorferi*: The agent of Lyme disease



# *B. burgdorferi*: The agent of Lyme disease



“typical” Gram-negative

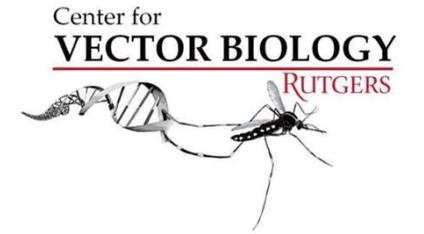


*Borrelia*



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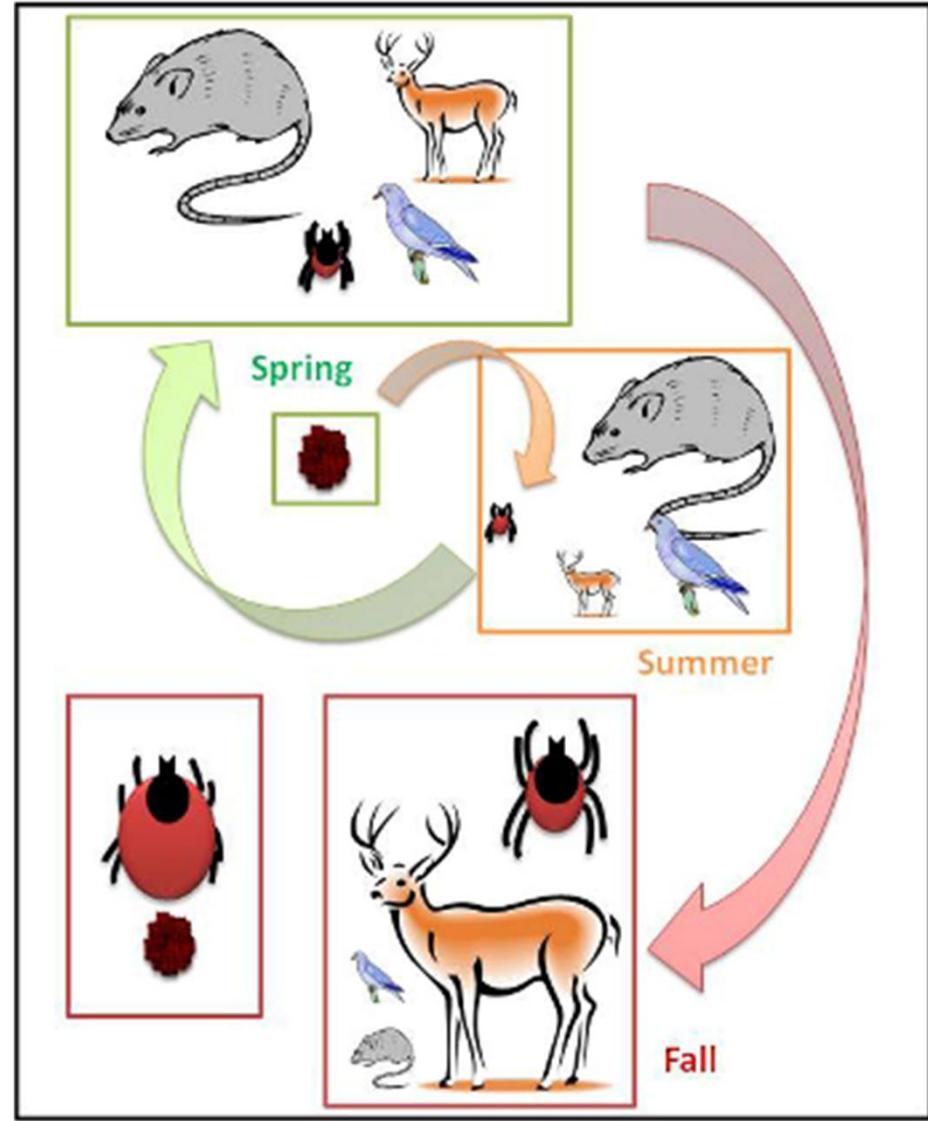
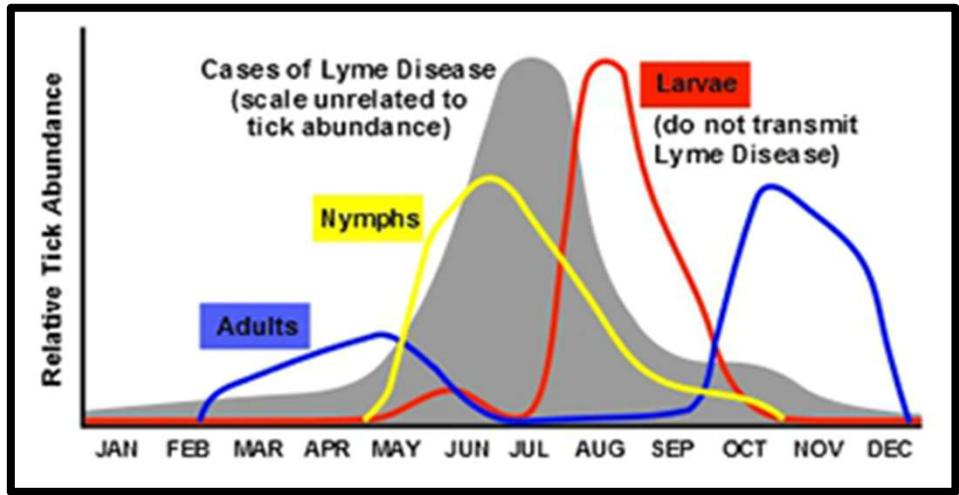
# Life cycle of *B. burgdorferi*



No trans-ovarial transmission  
Trans-stadial transmission



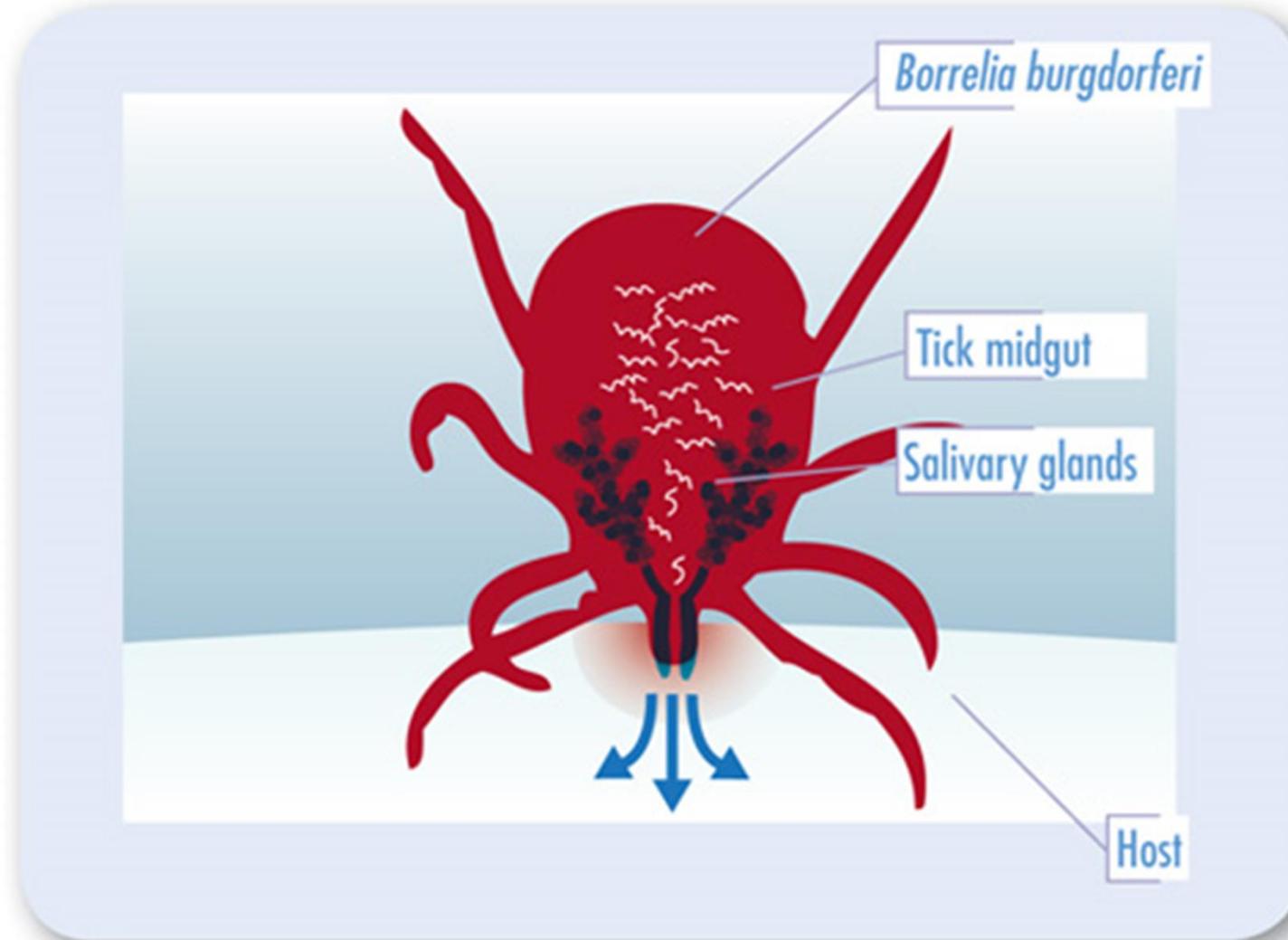
Only nymphs and adults can transmit the spirochete



Life cycle of *I. scapularis*. The tick has four stages in its two-year life cycle, egg, larva, nymph and adult. Between each stage the tick needs a blood meal in order to mature. The infectious agent is transstadially transmitted from one stage to another. The size of the animals represents the preferred host for each tick stage.

# Transmission of Lyme disease

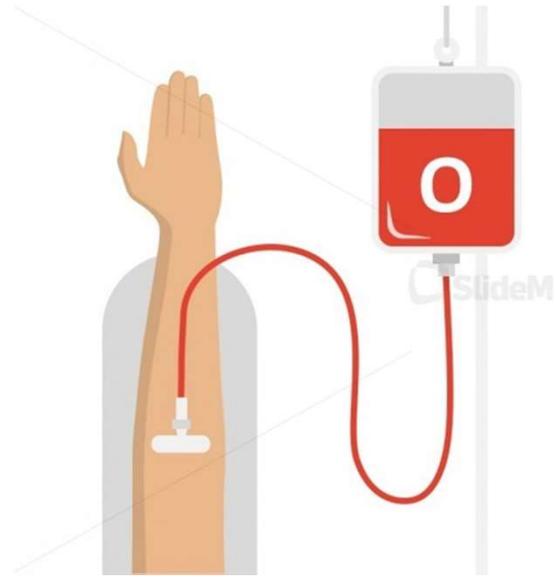
Tick midgut  
OspA/OspB



>24 h

Host  
OspC

# Can I get Lyme disease?



# Clinical manifestations of Lyme disease

- Erythema migrans (Early localized stage)
  - Cardiac involvement (Early dissemination)
  - Rheumatological involvement
  - Nervous system involvement
- } (Late disseminated stage)



# RUTGERS Lyme disease signs and symptoms



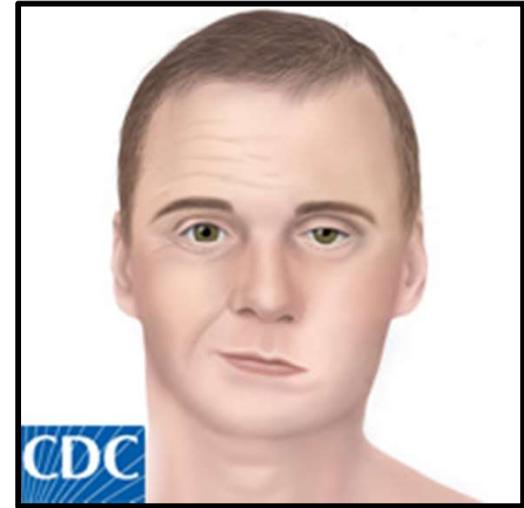
## Erythema migrans

7-14 days after infection  
70-80% of patients with LD



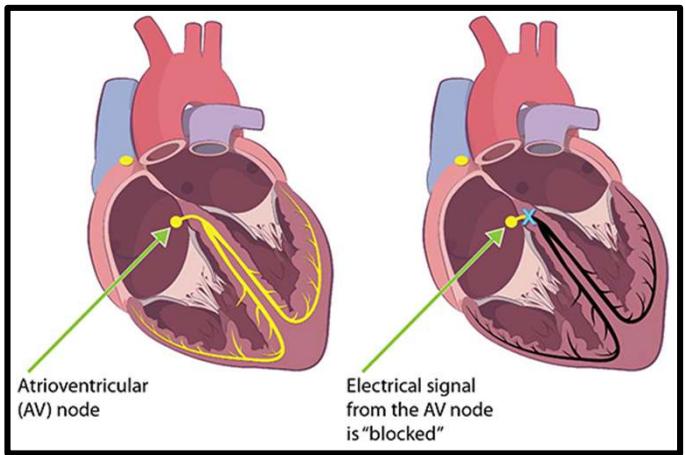
## Arthritis

Arthralgias and monoarthritis in major joints



## Neurologic signs

12% of confirmed cases of LD in the USA.  
Cause: Infiltration of spirochetes into the nervous system



## Carditis

### I. Conduction abnormalities

- I. Atrioventricular block
- II. Bundle-branch block
- III. Prolonged QTc
- IV. Ventricular tachycardia
- V. Fascicular tachycardia
- VI. Supraventricular tachycardia

Light-headedness, dyspnea, heart palpitations, or chest pain

1% confirmed cases of LD

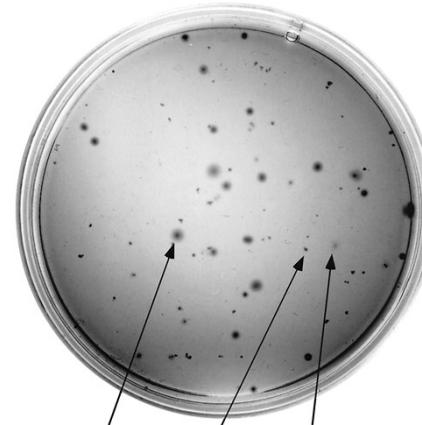
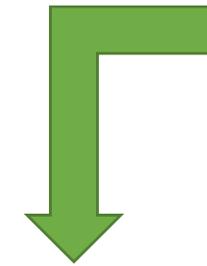


# Diagnosis of *B. burgdorferi*

Erythem migrans



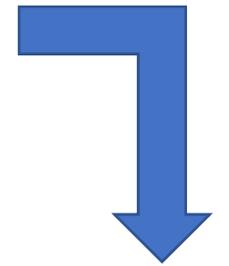
Culture



A large, diffuse, early  
B small, dense, late  
C small, irregular, late



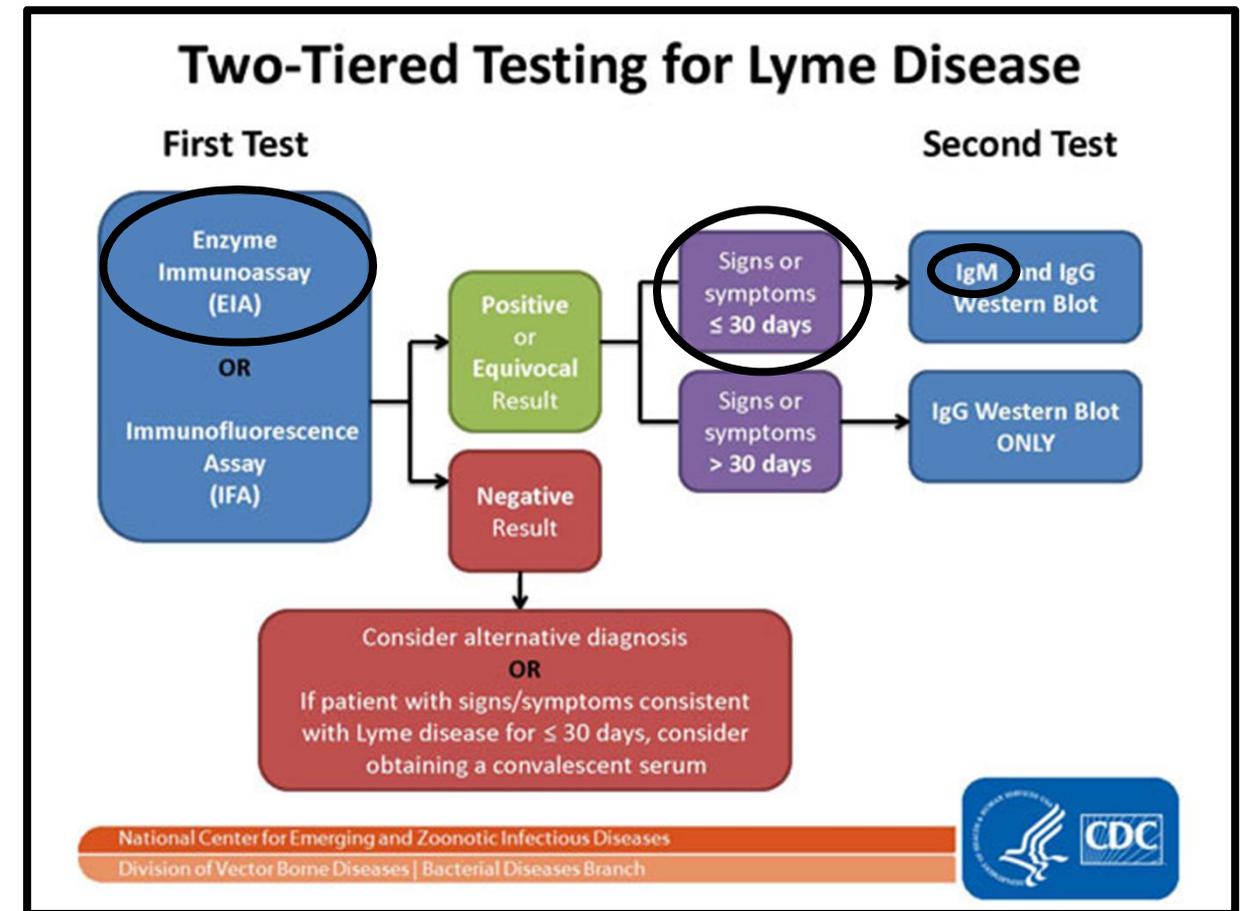
Molecular detection



# Laboratory diagnosis of *B. burgdorferi*

Two-tiered Serology: Gold Standard for serodiagnosis in North America

1. Two step process for measuring antibodies in blood against LD
2. Individual patients and epidemiological surveillance
3. FDA, CDC, IDSA,



# Lyme disease in children



Children have the highest incidence of Lyme disease (5-9 years old)

Clinical manifestations in children are similar to the manifestation in adults.

- Early localized Lyme disease
- Early disseminated
- Late Lyme disease

	Treatment	Adult dose	Pediatric dose
	Doxycycline (> 8 years)	100 mg/dose (2X)	4 mg/kg/day (2 divided doses)
	Amoxicillin	500 mg/dose (3X)	50 mg/kg/day (3 divided doses)
	Cefuroxime axetil	500 mg/dose (2X)	30 mg/kg/day (2 divided doses)
Intravenous	Ceftriaxone	2g every 24h	50-75 mg/kg/day every 24h
	Cefotaxime	2g every 8h	150-200 mg/kg/day every 8 h
	Penicillin G	3-4 million units/dose every 4 h	200,000-400,000 U/kg divided every 4h



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Thank you!

