



Lyme Disease Curriculum

GRADES 4–6

TEACHER MATERIALS





Lyme Disease

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Lyme disease is a serious health concern in the United States and much of the world.

This curriculum has been designed to help teachers communicate the facts about Lyme disease and tick-bite prevention to students as part of the science curriculum or as an aspect of general health education.

This material has been organized with teacher notes and information first—including a PowerPoint slide presentation for teachers—followed by handouts, worksheets and activities for students. The student material may be used in any order or sequence.

Curriculum Goal:

To teach students about Lyme disease so that they will understand:

- How it is transmitted
- Symptoms
- Medical treatment
- Best methods of prevention

Note: The student portion of this material is designed to be used in two ways:

1. Before embarking on an extended field trip or outdoor education program where children may be in areas known to be tick habitats, or
2. As part of a general health education curriculum.

Objectives:

By the end of this unit, students will be able to:

1. Identify and understand the cause, signs and treatments of Lyme
2. Identify and understand how to execute measures to **prevent** Lyme disease, including correct steps to take if someone is bitten.

Sequence of Material:

- Teacher Overview and Key Facts
- Teacher PowerPoint
- Student Materials and Activities

Standards:

This material has been developed with the California Department of Education's Next Generation Science Standards for Grades 4 through 6 and Grade 5 Health Education Standards as references:

www.cde.ca.gov/pd/ca/sc/ngssstandards.asp

and

www.cde.ca.gov/be/st/ss/documents/healthstandmar08.pdf

(see Personal and Community Health, page 25)

TEACHER OVERVIEW

This section of material has been designed to provide teachers with information so you can present a lesson or sequence of lessons about Lyme disease to students. Students will likely have questions about Lyme disease, ticks, and the bacteria that causes Lyme disease. It is important that they are made aware of the facts about Lyme, but that the information is presented in a non-scary way—especially if you are preparing to go on a field trip where ticks are known to be present or embarking on an outdoor education program.

We hope we have covered everything you need. If not, please email us at info@bayarealyme.org.

Lyme Disease—KEY FACTS students should know

1. Lyme disease is the **most common and fastest growing vector-borne disease** in the United States today.
2. The Centers for Disease Control (CDC) estimates that there are approximately **500,000 new cases** of Lyme disease every year. Bay Area Lyme believes the number to be over 620,000.
3. Lyme disease has been reported in **all 50 states**—it's not just an East Coast problem.
4. In warmer regions like California, Texas and Florida Lyme disease **can be contracted year-round**.
5. Children are more susceptible to contracting Lyme disease than adults as they are closer to the ground and are more likely to play in grasses and woodlands, sit on logs, and have physical contact with tick habitat.

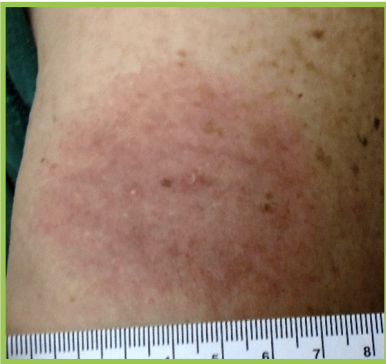
What is Lyme?

1. Lyme disease is an infection caused by a bacteria called *Borrelia burgdorferi*.
2. This bacteria has a distinctive corkscrew or spiral shape, so it is known as a **spirochete**.

3. It can be transmitted to humans through a **tick bite**.
4. The tick that can transmit Lyme disease in much of the eastern and central USA is the *Ixodes scapularis*, or blacklegged tick. The tick that can transmit Lyme disease in much of the western USA is the *Ixodes pacificus*, or western blacklegged tick.
5. Ticks are both a **parasite** (relies on other animals for food) and a **vector** (carrier of bacteria that it transmits from one animal to another).
6. The bacteria that causes Lyme disease was first **identified in the USA in Lyme, Connecticut** in 1982.
7. Ticks carry other microorganisms which are responsible for a variety of diseases known as **co-infections**, such as **Anaplasmosis, Babesiosis, Bartonella, Colorado tick fever, Ehrlichiosis, Rocky Mountain spotted fever, Southern tick-associated rash illness (STARI), Tick paralysis, Tick-borne relapsing fever, Tularemia, and Powassan virus**. Note: not all of these infections are caused by the same species of tick.
8. **Early diagnosis and adequate treatment are essential** to avoid long-term health problems. (Early diagnosis is what is termed the “acute” stage of the disease when symptoms are localized—usually days or weeks after infection.)
9. Over 100 strains of *Borrelia burgdorferi* have been detected in the US; over 300 strains worldwide.
10. The sooner a tick is found and removed, the less chance it has to infect its human host.

Symptoms:

1. Symptoms may appear days, weeks, months or even years after an infected tick bite.
2. **Symptoms vary over time** so can be challenging to pinpoint.
3. **Erythema Migrans**—an expanding red rash known as an “EM” rash may be present.
4. Rash may appear in many forms and varies in size, shape and location. The most common rash is a red solid oval (*see top left*).
5. The classic “bullseye” rash (*bottom left*) is the most widely recognized form, but **not everyone with Lyme gets a rash**.
6. **Common Early Symptoms:** rash, flu-like symptoms when no one else around you has had or has the flu—aches, fevers, stiff neck, stomach ache, headaches, joint, muscle pain, fatigue, swollen lymph nodes.
7. **Physical Signs and Symptoms:** facial paralysis or Bell’s Palsy, meningitis, encephalitis, heart problems, conjunctivitis, speech difficulties, dizziness, motor tics, stabbing and shooting pains, numbness, tingling, swollen joints, severe fatigue.
8. **Psychiatric and Cognitive Symptoms:** attention difficulties, “brain-fog”, problems concentrating, planning and organization, memory problems, changes



Solid oval rash



Bullseye rash

in sleep patterns, behaviors—outbursts and irritability. Psychiatric problems could include obsessive/compulsive disorder (OCD), anxiety, depression, panic attacks, eating disorders and psychosis. A **sudden** onset (2–3 days) of psychiatric and/or cognitive symptoms in children may indicate a tick-borne infection.

Diagnosics, Testing and Treatment

1. Current blood tests administered to diagnose Lyme disease can miss up to 60% of cases.
2. A negative result on a Lyme test does not definitively rule out infection.
3. Someone who has had exposure to ticks or a tick bite and is experiencing symptoms should be seen by a medical professional to be evaluated for Lyme and other tick-borne infections.
4. Ticks that are found embedded in the body and removed may be tested for the *Borrelia burgdorferi* bacteria and other tick-borne infections. These tests can detect several pathogens that may be present in the body of the tick. However, even if the tick is carrying the bacteria, it does not mean that the bacteria was transmitted (see: What is Lyme? Point 10).
5. It's also important to remember that many people don't see their tick bites (ticks can hide on the scalp, behind the knee, in the belly button, etc) so if someone has symptoms but never saw an attached tick, the person should still be evaluated for tick-borne diseases.
6. Different pathogens and different stages of Lyme disease may require different diagnostic tests and different treatments.
7. If diagnosed within days or weeks of infection, antibiotics such as doxycycline or amoxicillin are usually prescribed to treat the *Borrelia burgdorferi* bacteria infection.

Bacteria and Ticks

1. The bacteria that causes Lyme is called *Borrelia burgdorferi*.
2. Bacteria are single-celled microorganisms.
3. Bacteria are able to survive in many types of environments, in and on the human body.
4. Most bacteria cause no harm to people, but some are the causes of infection as they move from one environment to another.
5. Bacteria that cause infection leave an existing "reservoir"—either within the current host or in another host—and cause infection in another place—like an animal or human.
6. When a bacteria is living in its reservoir host organism, it generally doesn't harm the organism.

7. The reservoirs for the *Borrelia burgdorferi* bacteria are specific types of small mammals and birds that maintain the infection in the environment; the grey squirrel and white-footed mouse are known to be the most “effective” reservoirs in the US but other reservoirs also exist.
8. The *Borrelia burgdorferi* bacteria that causes Lyme disease in humans is distinctive: it is a corkscrew or spiral shape and is therefore known as a spirochete.

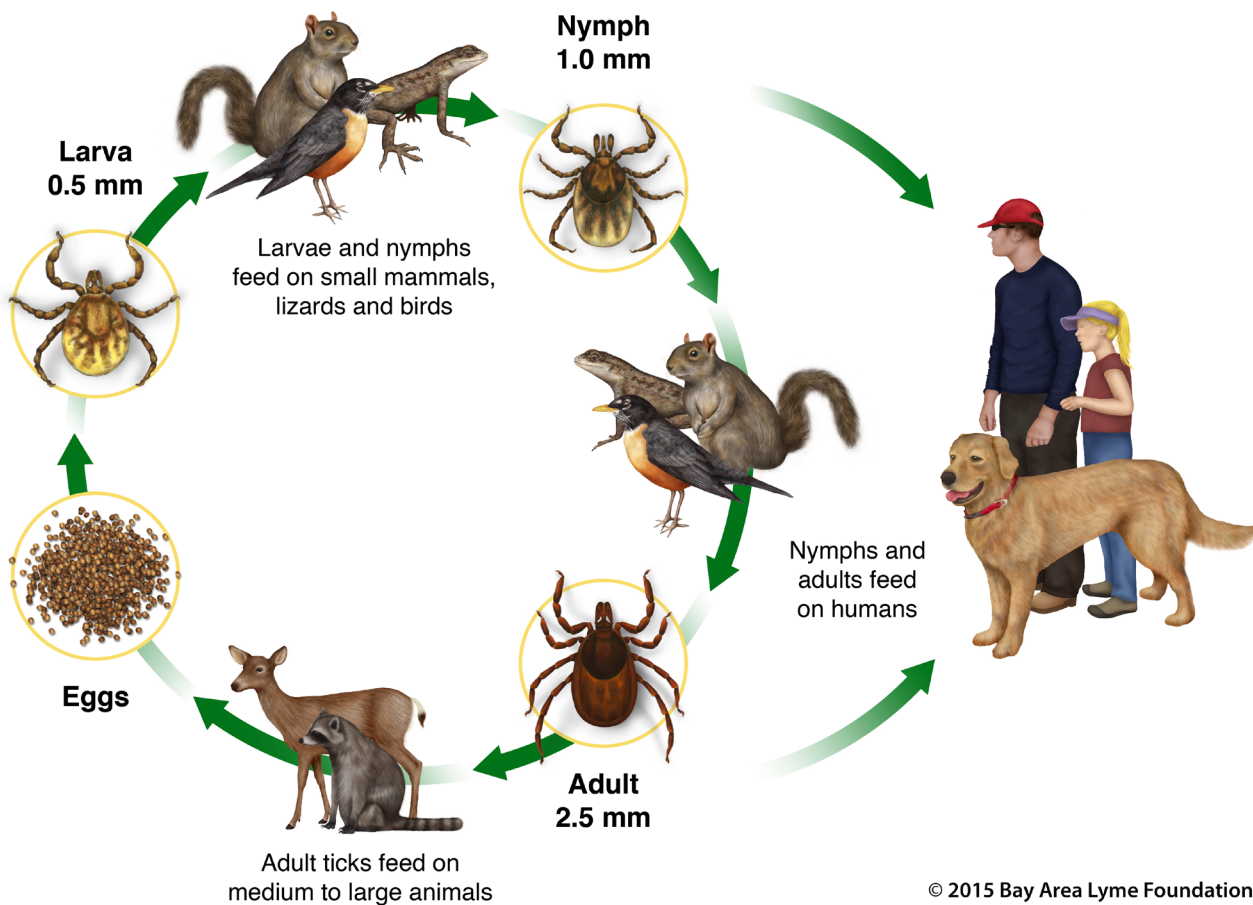
The Tick Life Cycle

1. The blacklegged tick has a 2–3 year life cycle and many animals play a role in its journey from larva to adult.
2. Adult ticks lay eggs in leaf litter, grasses, and other habitats.
3. The tick eggs hatch into larvae.
4. Tick larvae feed on the blood of small mammals, birds, and lizards. That’s when the bacteria that can cause Lyme disease can pass from the reservoir host (if the host is infected) into the tick. The tick is then infected with the *Borrelia burgdorferi* bacteria. The nymph—which can be the size of a tiny poppy seed—waits for its next blood meal in grasses, leaf litter, tree trunks, and other outdoor habitats. When a mammal, bird, or lizard presents itself as the opportunity for its next meal, the nymph latches on to that creature and takes a blood meal. This is one of the stages of the tick’s life cycle when humans can be bitten. Nymphs will also feed off of dogs and/or small woodland mammals—and again, if the small mammal it feeds on is infected, it will ingest the bacteria. If the tick that bites the human at this point is already infected with the *Borrelia burgdorferi* bacteria, it may transmit the bacteria into the bloodstream of the human.
5. The nymph then molts into an adult tick. The adult tick needs one more blood meal from a large- to medium-sized mammal. This may be a deer, raccoon, a dog or a human. Once again, if the adult tick is infected with the spirochete, it can transmit the *Borrelia burgdorferi* bacteria to the animal if it is left to feed undetected.
6. After its final blood meal, the adult tick will reproduce, and the female tick will lay eggs.
7. In California, when the western black-legged tick larvae or nymph feeds on a California western fence lizard or alligator lizard, the immune system of these lizards kills the *Borrelia* bacteria in the lizard and in the tick. In effect, our California lizards disinfect the ticks of *Borrelia burgdorferi*. Lizards in other parts of the United States and around the world do not share this capability and can be a reservoir.

Challenges

1. Ticks are hard to detect. The nymphs are particularly challenging as they can be the size of a poppyseed.
2. Ticks excrete a numbing substance from their jaws and saliva when they bite. People rarely feel the tick when it latches on to their skin.

Tick Life Cycle Illustration



The tick feeds 3 times in 2–3 years.

3. Ticks can be found attached anywhere on the body. They are most often found on the head, thigh, and torso but they can be more difficult to spot in places like the groin, armpits, backs of knees, waistband, belly button, in the hair, and folds of skin in the neck and ears.
4. Ticks can carry multiple different pathogens so one bite can infect a human with multiple pathogens.
5. There doesn't appear to be immunity after an infection, so it is possible to be re-infected with Lyme and other tick-borne diseases multiple times.
6. Diagnostic tests can be inaccurate for Lyme and some other tick-borne diseases.
7. Lyme disease symptoms are often broad and get misdiagnosed as other conditions.

Prevention

1. Wear light-colored clothing so ticks are more visible.
2. Wear long sleeves, tuck in shirts and long pants.
3. Consider using effective repellents such as DEET, lemon eucalyptus oil, and picaridin on the skin or Nootkatone and permethrin on clothing (easily obtainable from hardware stores and outdoor suppliers) to repel ticks.
4. Exercise caution when walking or sitting in tall grasses or wooded, leaf-littered areas. Consider using a (treated) picnic blanket and/or repellent. Check for ticks every day, especially if you have been in areas known to be tick habitats.
5. Feel for bumps on the skin, especially on the scalp, although nymphs can be difficult to feel because they are so small. Note that sometimes nymphal ticks are too small to feel with your fingers.
6. Pets can bring ticks into the house or car. Use preventative medication and check animals for ticks too.

Removal and Actions If You Find a Tick

1. If a tick is attached to your skin, get help; children should tell an adult.
2. Remove tick promptly following these directions:
 - a. Use fine-point tweezers as close to the skin as possible and gently but firmly pull the tick straight out.
 - b. Do not squeeze the belly of the tick to avoid squeezing the contents of its gut into your bloodstream.
 - c. Note: the longer the tick is attached, the greater the likelihood of Lyme disease transmission.
 - d. Clean the bite area with soap and water.
 - e. Place the tick in a zippered plastic bag with a piece of moist paper towel. Label the bag with the date and location.
 - f. Send it to a specialized laboratory for testing (i.e. www.tickreport.com). Or, if the tick has been sent home with a child, encourage parents to get the tick tested. See the RESOURCES tab on our website to download a tick bite documentation form (www.bayarealyme.org/resources).
9. Both live and dead ticks may be tested.
10. Watch for any new symptoms over the next few months.
11. See your healthcare provider if you suspect you may have contracted an illness and tell them about the bite

TALKING POINTS TO USE WITH STUDENTS

Here are some suggested talking points for teachers to use with class (or classes):

1. Lyme disease is a serious health issue, but it is preventable.
2. Stay on trails and avoid grasses, leaf litter, and bushes.
3. Consider using repellents such as DEET, oil of lemon eucalyptus or picaridin, and treat clothing with permethrin
4. Tick check DAILY—especially when showering.
5. Do not panic if you find a tick! Ask an adult for help.
6. Simple steps will minimize a person’s risk for contracting Lyme and other tick-borne infections.
7. If you get a tick, remove it immediately using fine-point tweezers.
8. Be vigilant about checking for symptoms.
9. Go to the doctor if you think you have been exposed to Lyme or another tick-borne infection.
10. It is possible to cure Lyme disease if people are aware and antibiotic treatment is given soon after a bite.
11. You need to be your own advocate if your doctor is skeptical.
12. Right now, diagnostic tools for Lyme are only 40–80% accurate.
13. Even if you get a negative result if you still don’t feel well, go back to your doctor—trust your instincts.
14. Lyme is the fastest-growing tick-borne disease in the United States today.
15. CDC estimates that there are almost 500,000 new cases of Lyme disease each year in the USA. Bay Area Lyme believes this number to be higher.
16. Because it’s hard to detect and diagnose, people may have Lyme and not even realize it.
17. Scientists are working hard to develop new ways to diagnose Lyme disease and find a cure.

SUGGESTED LESSON PLAN/MINI-UNIT ON TICKS AND LYME

We recommend that teachers use this material as a two-day mini-unit to teach students about ticks, tick-borne diseases and Lyme disease prevention. The ideal unit would be two 45–55-minute lessons with a take-home/homework assignment between the two lessons.

However, teachers may adapt and change the timing and assignments as required.

This unit is designed to be of particular use in advance of a field trip where a class is headed outdoors for the day, or an extended one-week residential outdoor education program when students may be exposed to ticks, but it is just as relevant as a general health education unit.

LESSON 1: (60 minute time slot)

> Introduction (3 mins)

- Explain to students that they will be doing a mini-unit about ticks and Lyme disease.
- Be sure to help them understand why they are learning about this and its importance (e.g. they are about to go to outdoor education, it's part of a health unit, etc).

> **Ask questions**—what do students know about ticks, tick-borne diseases and Lyme? What are things that they want to learn? (5 mins)

- Create and fill out a chart with what they currently know and what they want to learn during the unit. This way, you can check things off the list as they learn them and they will be able to actually see their progress.

> Show PPT (20 mins)

- Take your time with the slide presentation. Allow students to ask questions as you go through it—they will most likely have questions.

> **In-class assignment: Design mini-brochure** (20 mins). See **optional** template p. 15.

- Explain to the students that they will be creating an information brochure/pamphlet that they will use to educate someone at home about ticks and Lyme disease.
- **The brochure should include:**
 1. A cover with a picture and title.
 2. Information that will help someone avoid getting bitten by a tick.
 3. Information that will help them know what to do if they get bitten by a tick.
 4. Information that will help them identify the symptoms of Lyme disease.
 5. Important—for the graphing assignment on day two: students need to ask four adults if they have ever been bitten by a tick. They will record the answers on the back of the brochure with the signature of the person to whom they showed it.

> **Talking points to conclude** (7 mins)

- Ask students to think of three interesting new things they learned today.
- Have students share with their elbow partner (person sitting next to them) what their three things are.
- Once students have shared with their partner, have them share out as a class.
- Address the chart you made at the beginning of class and check off any items that they learned today that they did not know before it began.
- Hand out the packet for them to work on at home (you can have them do all of it, or part of it and finish the rest during day two).

HOMework

Complete student packet (all or selected items): cross-word, word search, fill in gaps, etc.

LESSON 2: (60 minute time slot)

> Discussion about brochure presentation

(5 mins)

Have students raise their hands to share their experience with educating their families at home with their brochure.

- What did the adults know?
- What did the adults not know?
- Did anyone they educated have experience with ticks?

> Packet (15 minutes)

Whatever portion of the packet that students did not complete for homework may be completed at this point in class.

> Math/graphing extension (25 mins)

- Students will graph their data from the night before as well as the results of their tick bite survey of 4 classmates.
- Students might need to start this assignment as a class before finishing on their own.
- Once students are done, have them share their 'results' and discuss what they think it means.

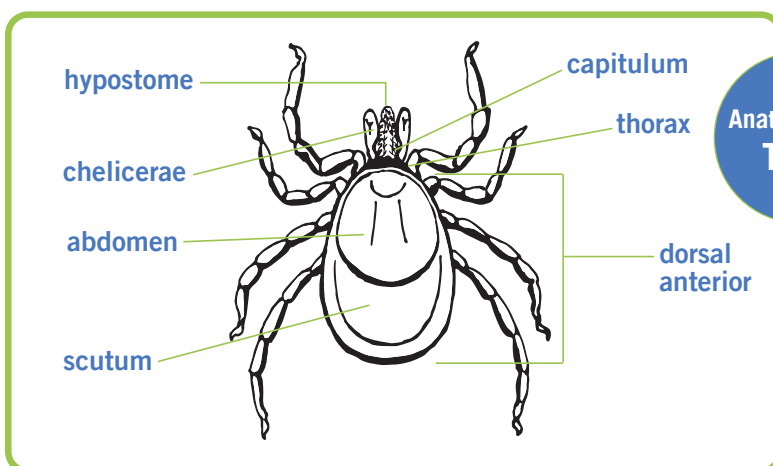
- Example: if they noticed that more adults than children have been bitten by ticks, ask them why they think that is (having more exposure over a longer lifetime, not being educated about tick bite prevention when they were kids, etc).

> Take quiz (10 mins)

- Give students the quiz.
- Allow plenty of time to complete the quiz to ensure they are not rushed.
- Grade quiz together, as a class, so students immediately can rectify incorrect answers.
- See below for the Quiz Key

> Closing conversation (5 min)

- Now that students have learned so much about ticks, look over the chart from the day before and check off what they now know (do this as a class).
- Ask students to think about and share why they think it's so important for people to learn about ticks and Lyme disease.
- Praise them for learning about Lyme disease and for being ambassadors to help educate others about the risks of ticks and Lyme disease

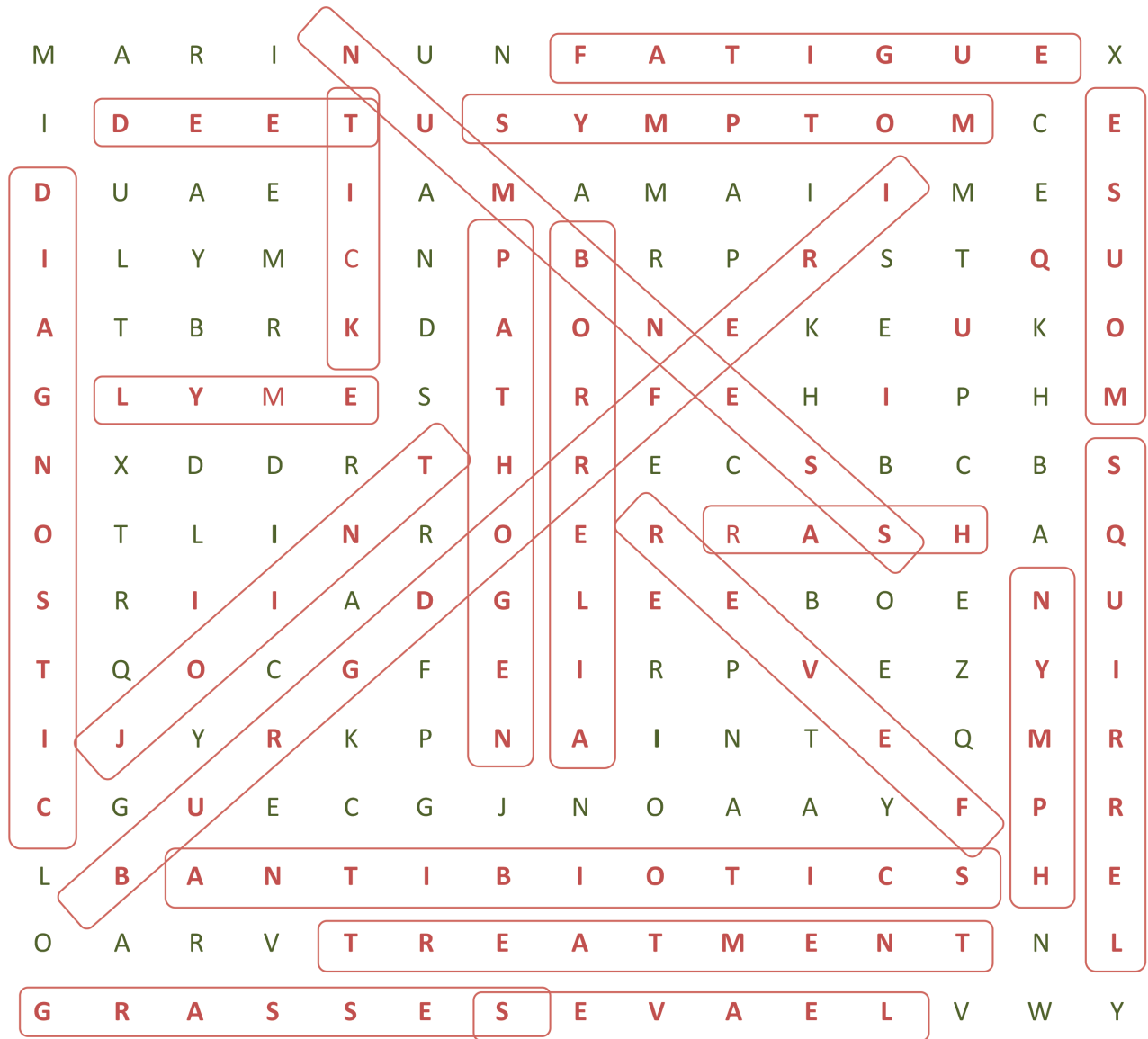


Anatomy of a TICK

Page 14 QUIZ KEY:	
1. B	5. D
2. D	6. E
3. D	7. E
4. B	8. D

What do you know about ticks?

Test your knowledge with this word search



Find the words in the puzzle above – be sure to look forwards, backwards, up, down and diagonal!



Bay Area Lyme
FOUNDATION

- | | | | |
|-------------|----------|-------------|----------|
| LYME | MOUSE | DIAGNOSTIC | FATIGUE |
| TICK | SQUIRREL | TREATMENT | JOINT |
| NYMPH | GRASSES | ANTIBIOTICS | FEVER |
| BORRELIA | LEAVES | SYMPTOM | NUMBNESS |
| BURGdorFERI | PATHOGEN | RASH | DEET |

Visit www.bayarealyme.org for clues.

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EclipseCrossword.com

Name: _____

QUIZ ON LYME DISEASE AND TICKS

1. What causes Lyme disease?

- a. A virus in the blood
- b. A bacterial infection from a tick bite
- c. A spider bite
- d. Eating too many limes

2. What animals carry the bacteria that causes Lyme disease?

- a. Ticks
- b. Mice
- c. Squirrels
- d. All of the above

3. What are the three stages of a tick's life?

- a. Grub, cocoon, tick
- b. Egg, nymph, adult
- c. Egg, nymph, chrysalis, insect
- d. Egg, larva, nymph, adult

4. What should you do if you are bitten by a tick?

- a. Cover the tick with a band aid
- b. Pull the tick straight out of the skin using tweezers and save it in a Ziploc bag
- c. Squish the tick with your fingers

5. What are the symptoms of Lyme disease?

- a. Extreme fatigue with muscle and joint pain
- b. A rash that moves and/or spreads for 3–30 days post bite

- c. Headaches and flu-like symptoms
- d. All of the above

6. What is the best way to prevent getting Lyme disease?

- a. Stay in the middle of trails
- b. Be cautious in grasses, leaf litter, logs, and tree trunks
- c. Wear light-colored clothing treated with tick repellent
- d. Tick-check every day
- e. All of the above

7. If you find a tick on your body you should

- a. Tell an adult
- b. Remove the tick safely
- c. Save the tick for testing
- d. Watch yourself for symptoms and see your doctor
- e. All of the above

8. When you check yourself for ticks, what parts of the body need close attention?

- a. Hair, scalp, and neck
- b. Armpits and backs of knees
- c. Groin and waistband
- d. All of the above

Symptoms

Notes and Information Collected

Student name: _____

showed me this information on: _____

Adult signature: _____

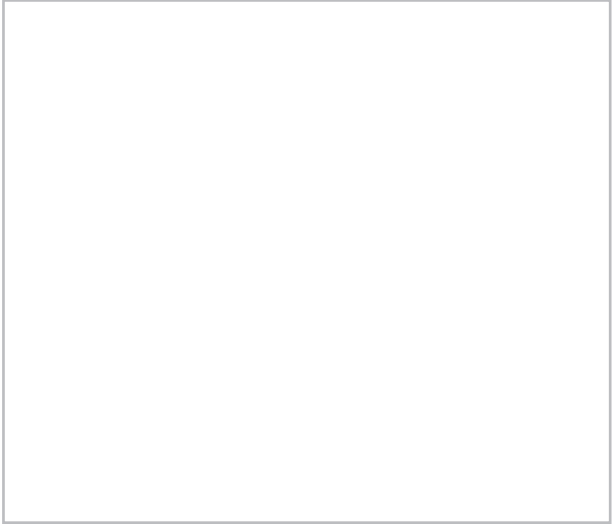


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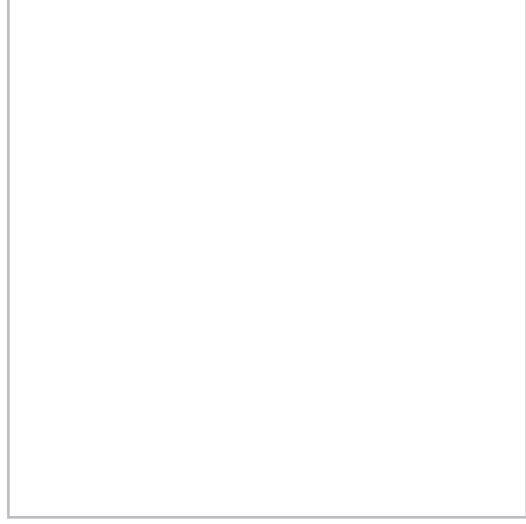
For more information about tick-borne
diseases and Lyme, please visit the
Bay Area Lyme Foundation:
www.bayarealyme.org

Tick-Bite Education and Prevention from TickSense!

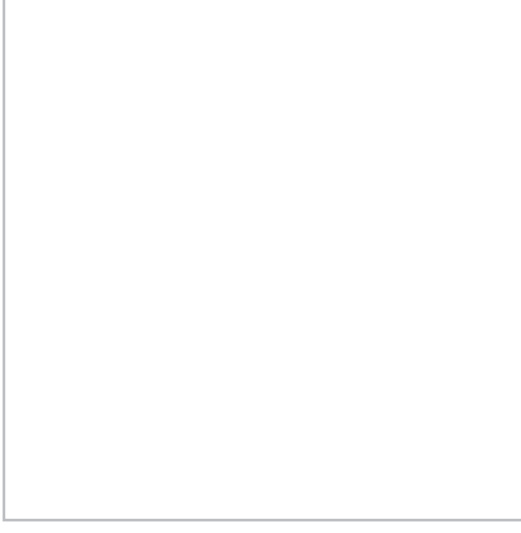
Introduction



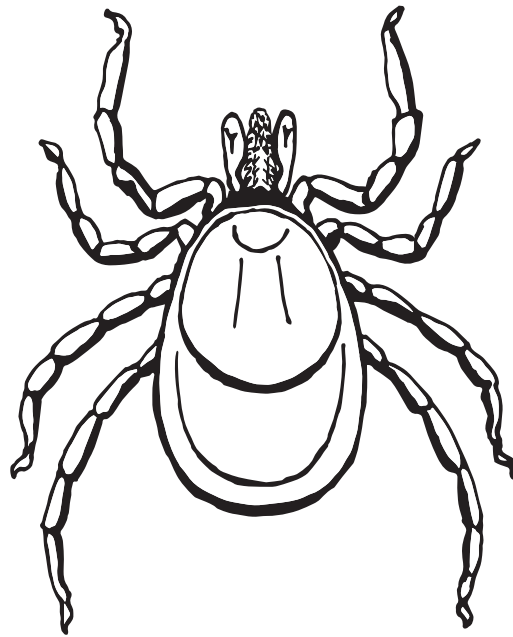
What You Should Know



Prevention Tips

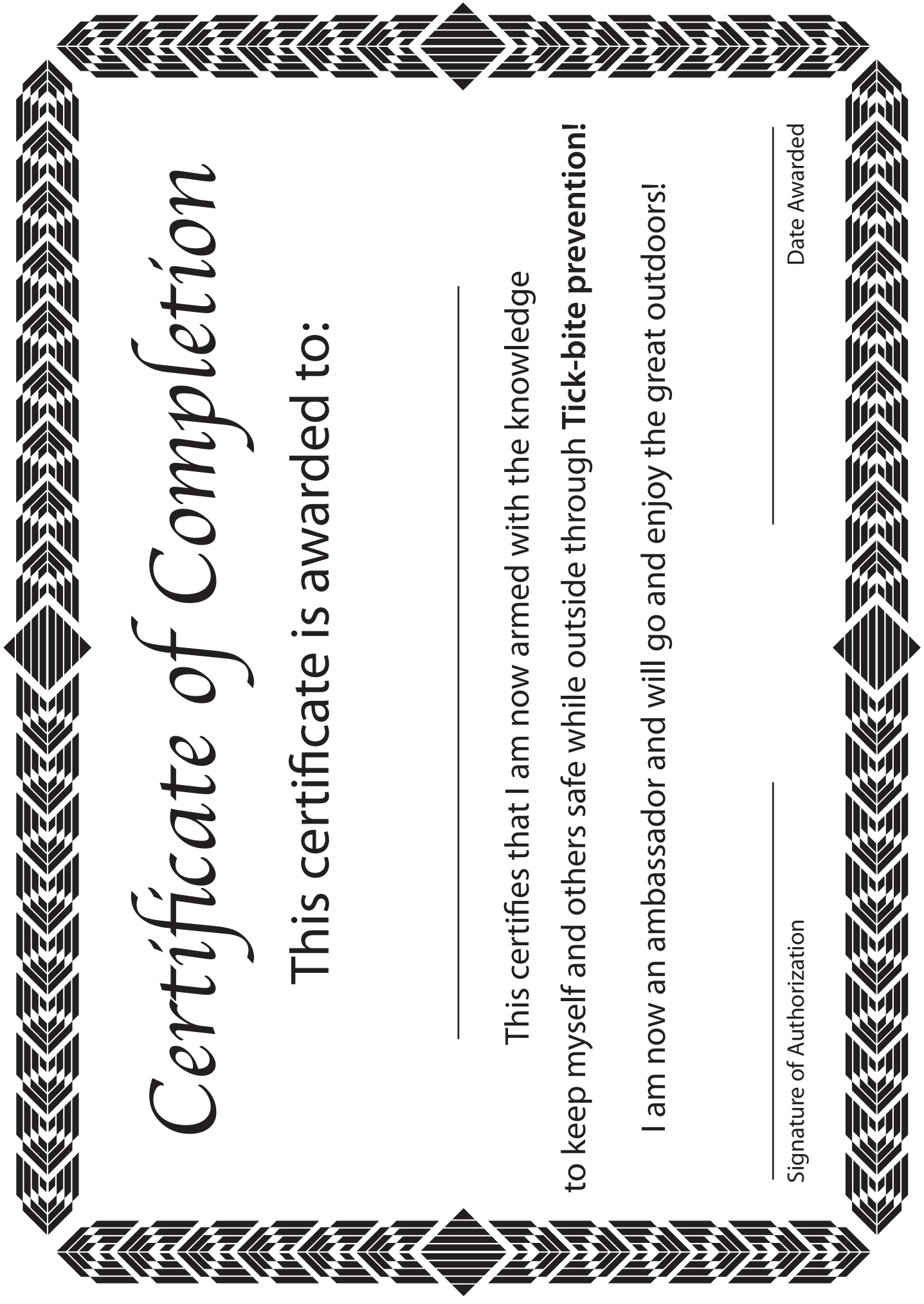


**LABEL THE PARTS
OF THE TICK**



FILL IN THE BLANKS (hint: the number of letters in the word is after each blank!)

Ticks are not insects, they are arachnids (8). They belong to the same family as mites and spiders (6) and have eight (5) legs. They have a life cycle that lasts two (3) years and undergo metamorphosis (13) to get to their adult stage. In order to change from one stage to another, ticks need a meal of blood (5). When ticks bite a mammal, they insert their mouthpart called the hypostome (9) into the top layer of the mammal's skin called the epidermis (9). They feed by tapping into tiny vessels in the skin called capillaries (11). If they are infected with the bacteria borrelia (8) burgdorferi (11) which is the bacteria that causes Lyme (4) disease, they may transmit the bacteria into the mammal. If the mammal is a human, that person may get very sick. There are ways to prevent tick bites to reduce the chances of getting bitten. These include: walking in the middle (6) of the trail; avoiding tall grasses, bushes, leaf litter (6) and logs; wearing clothing that is light-colored with long (4) sleeves and pants; using tick repellents; and conducting tick (4) checks daily when showering.



Certificate of Completion

This certificate is awarded to:

This certifies that I am now armed with the knowledge
to keep myself and others safe while outside through **Tick-bite prevention!**

I am now an ambassador and will go and enjoy the great outdoors!

Signature of Authorization

Date Awarded

NOTES



About Bay Area Lyme Foundation

Bay Area Lyme was founded in 2012 by a group of concerned individuals determined to make Lyme disease easy to diagnose and simple to cure. Although primarily a medical research foundation that grants funding to scientists and researchers to progress the search for a cure, Bay Area Lyme is also committed to preventing new cases of the disease. Our education outreach program provides tick and Lyme disease information for outdoor education programs, environmental educators, park rangers, first responders, medical professionals, scientists and classroom teachers. We have downloadable resources on our website: www.bayarealyme.org/educators for more information.