

LYME DISEASE

is a **tick-borne, inflammatory infection** caused by the bacteria *Borrelia burgdorferi*. In North America, the most common vector for *Borrelia* is the blacklegged tick (aka deer tick) *Ixodes scapularis*.

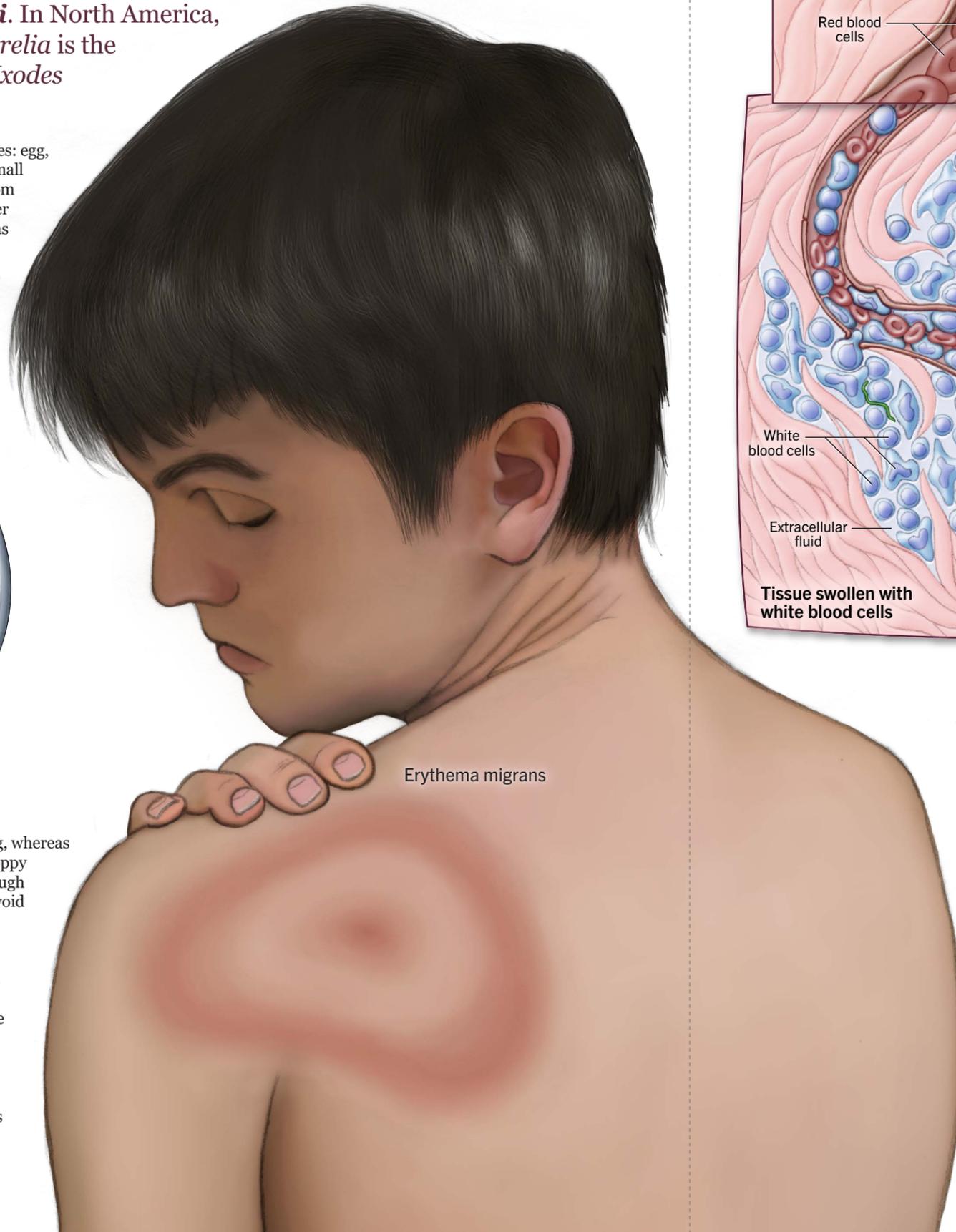
The tick's **2-year life cycle** consists of four stages: egg, larva, nymph, and adult. As larvae, ticks feed on small animals such as mice, and can acquire *Borrelia* from these carriers. Nymph and adult ticks feed on larger animals, and may transmit the pathogen to humans at this stage. Ticks feed for several days at a time, but *Borrelia* is not transferred from the tick to the host until at least the second day; thus, people who spend time in tick-infested areas can greatly reduce their chances of contracting Lyme disease by checking for and removing all ticks promptly after each exposure.



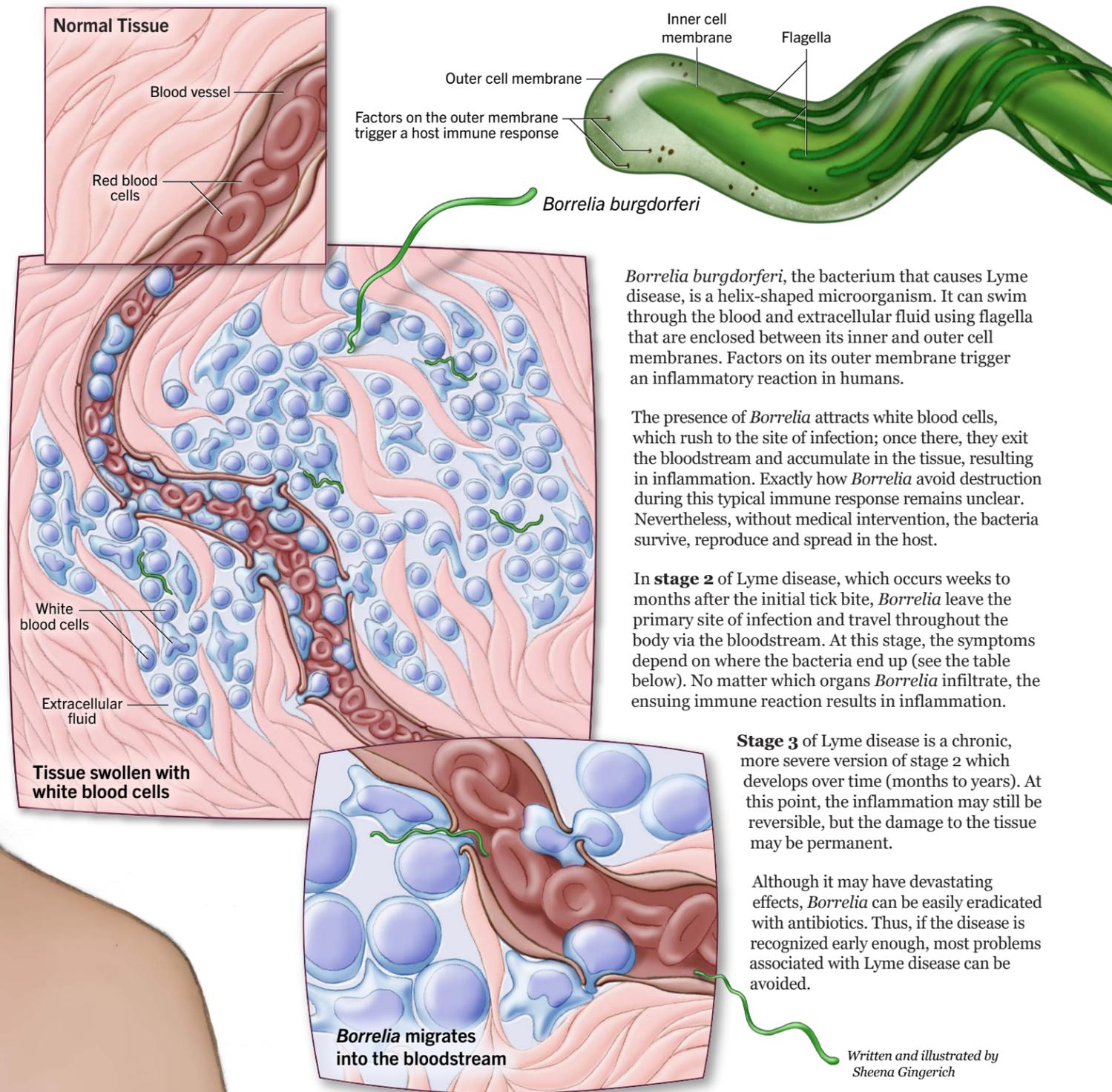
Approximately 4X actual size

Before a feeding, adult deer ticks are 2 - 3 mm long, whereas nymphs are 1 - 1.5 mm long—about the size of a poppy seed. Most infections in humans are acquired through nymphs, because their small size allows them to avoid detection for long enough to transmit the bacteria.

Three clinical stages describe the progress of Lyme disease. During **stage 1**, the reaction is local to the site of the tick bite. Typically, a large (>5 cm in diameter) skin lesion spreads outwards from the centre of the bite; this rash is called erythema migrans. A dark border to the rash gives it the appearance of a bullseye target. Other stage 1 symptoms may include flu-like symptoms such as headaches, fever and fatigue. Erythema migrans is the best indicator of Lyme disease, as it is the most common and the most distinct symptom.



Erythema migrans



Borrelia burgdorferi, the bacterium that causes Lyme disease, is a helix-shaped microorganism. It can swim through the blood and extracellular fluid using flagella that are enclosed between its inner and outer cell membranes. Factors on its outer membrane trigger an inflammatory reaction in humans.

The presence of *Borrelia* attracts white blood cells, which rush to the site of infection; once there, they exit the bloodstream and accumulate in the tissue, resulting in inflammation. Exactly how *Borrelia* avoid destruction during this typical immune response remains unclear. Nevertheless, without medical intervention, the bacteria survive, reproduce and spread in the host.

In **stage 2** of Lyme disease, which occurs weeks to months after the initial tick bite, *Borrelia* leave the primary site of infection and travel throughout the body via the bloodstream. At this stage, the symptoms depend on where the bacteria end up (see the table below). No matter which organs *Borrelia* infiltrate, the ensuing immune reaction results in inflammation.

Stage 3 of Lyme disease is a chronic, more severe version of stage 2 which develops over time (months to years). At this point, the inflammation may still be reversible, but the damage to the tissue may be permanent.

Although it may have devastating effects, *Borrelia* can be easily eradicated with antibiotics. Thus, if the disease is recognized early enough, most problems associated with Lyme disease can be avoided.

Written and illustrated by Sheena Gingerich

Stages 2 and 3: Lyme Disease in Multiple Organ Systems

Organ or Tissue	Symptom
Skin	Additional erythema migrans
Joints (particularly the knees)	Arthritis
Muscle	Pain
Brain	Meningitis, encephalitis (swelling)
Heart	AV node blockage (irregular heartbeat)