

# A Twist of Lyme<sup>©</sup>



Using ELISA to diagnose Lyme disease

Student Guide

BioBus Educational Programs

Version 1

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Version 1

Name: \_\_\_\_\_

## **BIOBUS LABORATORY NOTEBOOK**

**TITLE OF EXPERIMENT:**

**OBJECTIVE:**

**PREDICTION:**

**EXPERIMENTAL PROCEDURE:**

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>

# BIOBUS LABORATORY NOTEBOOK CONTINUED

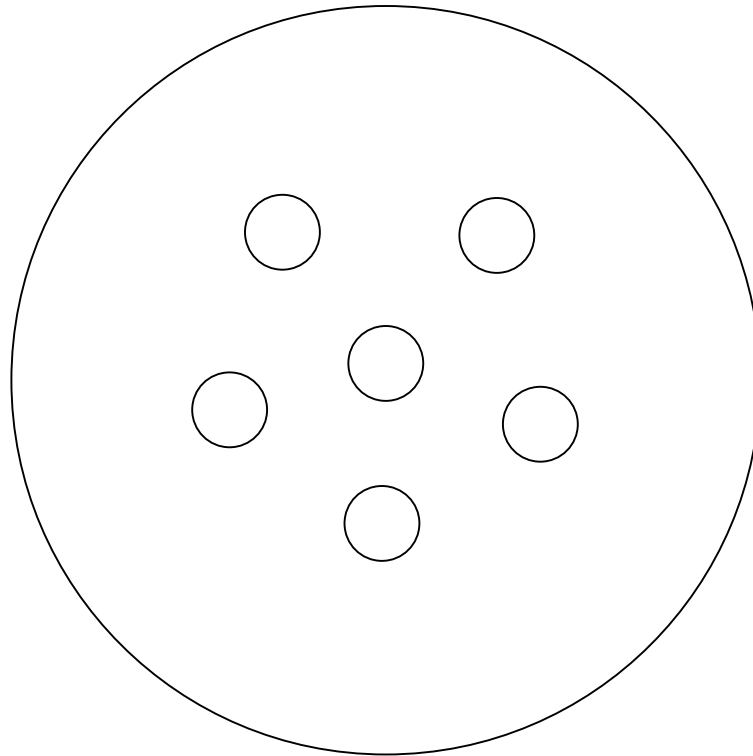
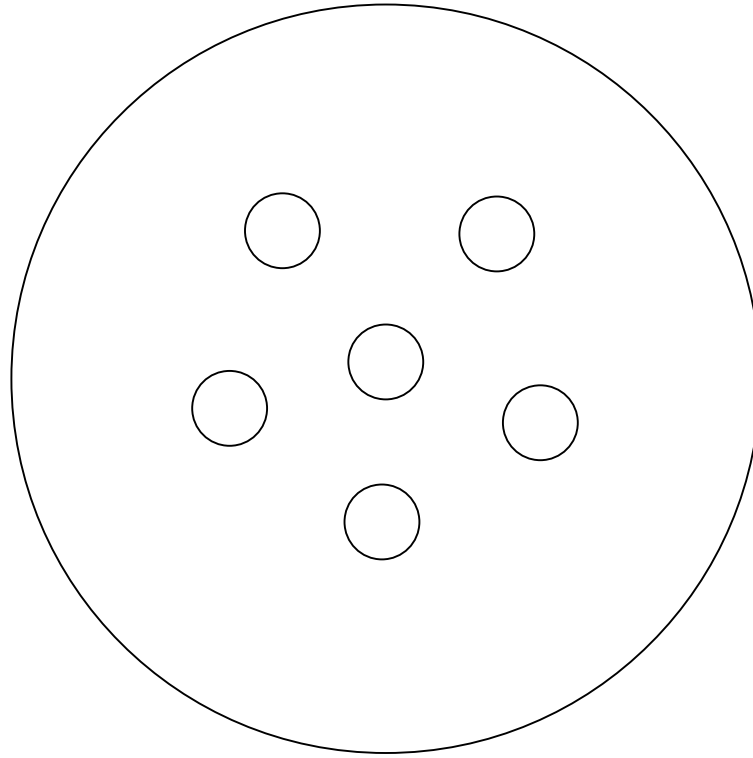
**EXPERIMENTAL PROCEDURE CONTINUED:**

**RESULTS:**

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>

**CONCLUSION:**

# Petri Dish Template



## STUDENT CASE BRIEF

In *A Twist of Lyme*, you will become a diagnostic laboratory technician, helping the BioBus staff determine whether patients have **Lyme disease**. Before we can perform the diagnostic testing however, it is important that everyone involved is familiar with some of the science behind it. The information below will provide you with some of the facts necessary for you to make a diagnosis.

### DISCOVERY OF LYME DISEASE

In the early 1970s, Yale University researchers noticed an unusually large number of children being diagnosed with juvenile rheumatoid **arthritis** in Lyme, CT and in neighboring towns. It was soon realized this was a distinct disease now termed Lyme disease.

Researchers discovered that the majority of children infected lived near wooded areas where ticks were present, and that their first **symptoms** were usually in the summer months when tick season was at its highest. Several patients also recalled being bitten by a tick and developing a skin rash at the bite mark before the onset of their arthritis. Scientists concluded that Lyme disease was caused by the bacterium *Borrelia burgdorferi*, which was transmitted to humans through **deer tick** bites.

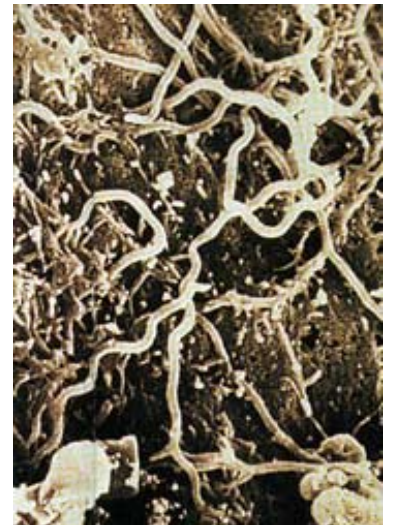
Since 1980, over 170,000 cases of Lyme disease have been reported. The number of cases as well as the number of geographic areas in which Lyme disease is found has been increasing. Lyme disease has been reported in nearly all of the United States and in large regions of Asia and Europe.

### SYMPTOMS

The most common symptom of Lyme disease is a red rash known as erythema migrans (EM). The rash starts as a small red spot at the site of the tick bite. The spot expands over time to form a circular or oval shaped rash that sometimes resembles a bull's eye, appearing as a red ring surrounding a clear area with a red center. The rash can range from the size of a dime to the width of a person's back and can appear at different sites on the body as the **infection** spreads. After several months of infection, patients may experience attacks of painful and swollen joints that last a few days to a few months. The arthritis can shift from one joint to another. About 10 to 20% of untreated patients will go on to develop chronic arthritis.

### DIAGNOSIS AND TREATMENT

Lyme disease is difficult to diagnose because many of its symptoms mimic those of other disorders. The only distinctive hallmark unique to Lyme disease (erythema migrans) is absent in at least 25% of patients.



□ *Borrelia burgdorferi* magnified with an electron microscope.



□ Examples of erythema migrans, the red bull's eye rash that may develop with Lyme disease.

Recent research indicates that an infected tick must be attached to a person's skin for at least 2 days to transmit the Lyme bacteria. Although a tick bite is an important clue for diagnosis, many patients cannot recall having been bitten by a tick. This is not surprising, as the deer tick is tiny, and the bite usually painless.

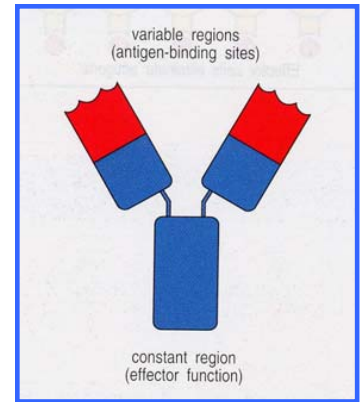
Nearly all Lyme disease patients can be effectively treated with **antibiotics**. In general, the sooner such therapy is begun following an infection, the quicker and more complete the recovery.

## INTRODUCTION TO IMMUNOLOGY

**Antibodies** are proteins produced by white blood cells in response to foreign material. Foreign materials, known as **antigens**, can be infectious agents (e.g. viruses or bacteria), environmental materials (e.g. pollen), or proteins. Antibodies, produced in response to an antigen, bind the antigen so that the immune system can remove it from circulation. An antibody is *very specific* for one particular antigen; it will not recognize any other antigen (like a lock and key). An antibody binds to an antigen due to its unique chemical structure. Each antibody has two antigen binding sites (see diagram at right).

## ELISA

The **Enzyme-Linked ImmunoSorbent Assay (ELISA)** is used to diagnose a variety of diseases and conditions including tumors, pregnancy, narcotic usage, HIV, herpes, and hepatitis. The ELISA for this experiment is designed to detect an antibody directed at a specific antigen: *Borrelia burgdorferi*, the bacteria which causes Lyme disease. Shortly after an infection with *Borrelia burgdorferi*, the body produces antibodies to seek out and destroy the foreign invader. The ELISA uses specific antigens found on the surface of *Borrelia burgdorferi* to detect the presence of antibodies. Therefore, the ELISA *does not* detect the presence of the bacteria itself, but rather it the *antibodies* that are made by the body to help fight off the bacteria.



□ Diagram of an antibody.



### Antibody

(an-ti-bā-dē) – A protein made by the immune system that recognizes and binds to a particular antigen to prevent that antigen from harming the body.

### Fact Files

#### ELISA Tests

ELISAs are used to diagnose many diseases and conditions including pregnancy, HIV infection, herpes, rubella, hepatitis, measles, mumps, and narcotic usage.

## GLOSSARY OF TERMS

**Antibiotic** - A drug that kills or greatly inhibits the growth of bacteria.

**Antibiotic Therapy** - A treatment that uses antibiotics to stop an infection. Antibiotic therapy requires the patient take one or more antibiotics for a specified length of time.

**Antibody** - A protein made by the immune system that recognizes and binds to a particular antigen to prevent that antigen from harming the body.

**Antigen** - Any foreign substance introduced into the body.

**Arthritis** - Inflammation of the joints in the body.

**Bacteria** - Single-celled organism.

**Borrelia burgdorferi** - The bacterium that causes Lyme disease.

**Deer Tick** - A tick frequently infected with *Borrelia burgdorferi* which transmits Lyme disease to humans through a bite.

**Enzyme** - A protein which catalyzes a biochemical reaction.

**Enzyme-Linked ImmunoSorbent Assay (ELISA)** - A scientific technique which measures antibody levels.

**Immune** - Not susceptible to a particular infection, usually because the body produces antibodies which recognize the antigen.

**Immunology** - The study of the immune system and its responses.

**Infection** - The result of an antigen attacking an organism.

**Infectious Disease** - A disease which can be easily passed on to many organisms within or between species.

**Inflammation** - The body's response to an infection or injury commonly characterized by pain, redness, heat and swelling.

**Lyme Disease** - An infection caused by the bacterium *Borrelia burgdorferi* which is transmitted through a deer tick bite.

**Lymphocyte** - A type of white blood cell which aids the immune system in fighting an infection, includes T-cells and B-cells.

**Macrophage** - A cell in the immune system which fights infections by engulfing antigens and breaking them apart.

**Specificity** - The condition of belonging to a particular group.

**Spirochete** - A spiral-shaped bacterium.

**Symptom** - Something which indicates the presence of a particular condition, disease or disorder.

**Vaccine** - A preparation of a weakened or killed form of a particular antigen that is administered to produce immunity to that antigen.

**White Blood Cell** - A component of blood which helps to defend the body against antigens.