6.1 Introduction

The immune system is a versatile defense method that has evolved to protect animals from invading pathogenic microorganisms. The immune response is the way body recognizes and defends itself against bacteria, viruses, and substances recognized as foreign and potentially harmful to the body. Functionally, an immune response can be divided into two related activities – recognition and response. The immune system is able to discriminate one foreign pathogen from another and also between foreign molecules and the body’s own cells and proteins. Once a foreign organism/antigen has been recognized, the immune system recruits a variety of cells and molecules to mount an appropriate response, called an effector immune response, to eliminate or neutralize the organism/antigen. Later exposure to the same foreign organism/antigen induces a memory immune response, characterized by a more rapid and heightened immune reaction that serves to eliminate the pathogen and prevent diseases (Goldsby et al. 2000).

6.2 Type of Immune Responses

The immune system is a complex set of cellular elements comprising different forms of lymphocytes and antigen-presenting cells to protect against infections.
The immune response is often divided into two types: the innate and the adaptive.

### 6.2.1 Innate Immune Response

This provides the first line of defense against infection, which includes cellular and molecular components that recognize a wide spectrum of conserved pathogenic components. It has broad reactivity and is uniform in all members of a species.

### 6.2.2 Adaptive Immune Response

This provides long-lasting and specific protection against known pathogens. It has a high degree of antigen specificity and memory. The major agents of adaptive immunity are lymphocytes, antibodies, and other molecules they produce. The adaptive immune system, also called the acquired immune system, ensures that most mammals that survive an initial infection by a pathogen are generally immune to further illness caused by that same pathogen. This chapter describes specifically various techniques to study adaptive immune responses developed in mammals. The immune system operates throughout the body. However, there are certain sites where the cells of the immune system are organized into specific structures. These are classified as central lymphoid tissue (bone marrow, thymus) and peripheral lymphoid tissue (lymph nodes, spleen, mucosa-associated lymphoid tissue). The location of various lymphoid tissues in mice is shown in Fig. 6.1. Immune cells are formed in the bone marrow and are grouped into two major classes: lymphocytes and antigen-presenting cells (APC). Once the lymphocytes are initially formed, some continue to mature in the bone marrow and become B cells. Other lymphocytes finish their maturation in the thymus and become T cells. Once mature, some lymphocytes stay in the lymphoid organs, while others travel continuously around the body through the lymphatic vessels and bloodstream.

### 6.3 Adaptive Immune System

In mammals, the adaptive immune system is divided into two classes: humoral and cellular.