

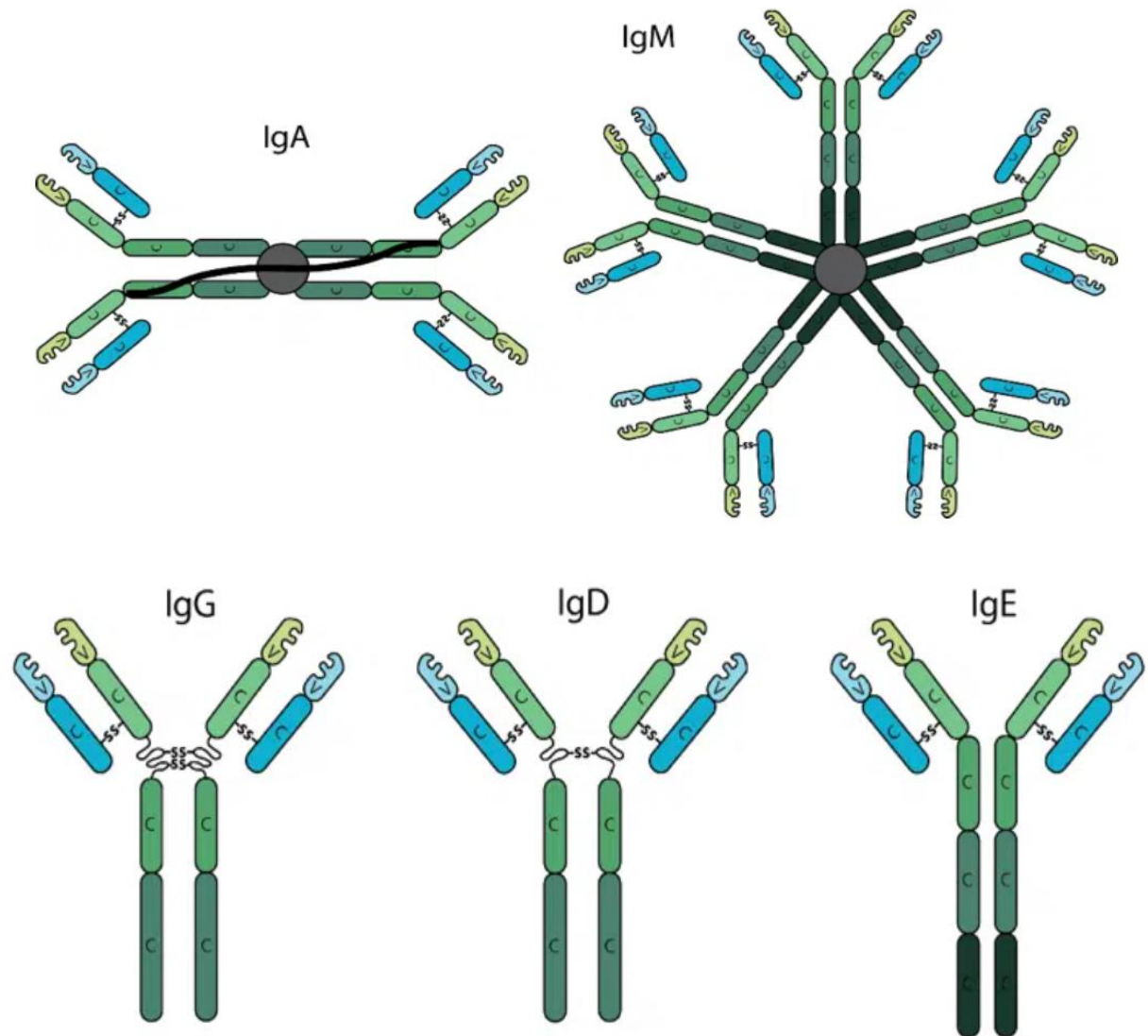
Antigen and Antibody Reaction

Antigen: is any substance that can provoke an immune response in the body. Antigens are typically proteins or polysaccharides found on the surface of pathogens like bacteria, viruses, and fungi, but they can also come from non-pathogenic sources, such as pollen, food, and even transplanted tissues. When an antigen enters the body, the immune system recognizes it as foreign and produces antibodies to neutralize or destroy it.

Antibodies: are proteins (or immunoglobulins) produced by the immune system to identify and neutralize foreign objects like bacteria and viruses. Each antibody is specific to a particular antigen, which is a substance that triggers an immune response.

There are five main classes of antibodies in humans:

- 1- **IgG (Immunoglobulin G):** The most abundant antibody in the bloodstream, IgG plays a crucial role in the immune response. It can cross the placenta, providing passive immunity to the fetus.
- 2- **IgA (Immunoglobulin A):** Found in mucosal areas (like the gut and respiratory tract) and in secretions such as saliva, tears, and breast milk. IgA helps protect mucosal surfaces from infection.
- 3- **IgM (Immunoglobulin M):** The first antibody produced in response to an infection. It is effective in forming complexes with antigens and activating the complement system.
- 4- **IgE (Immunoglobulin E):** Involved in allergic reactions and responses to parasitic infections. IgE binds to allergens and triggers histamine release from mast cells.
- 5- **IgD (Immunoglobulin D):** The least understood antibody, primarily found on the surface of B cells. Its function is not fully known, but it is believed to play a role in B cell activation and regulation.



Antigen –Antibody Reaction

The reaction between antigens and antibodies is a fundamental aspect of the immune response.

Binding Mechanism: When an antibody encounters its specific antigen, it binds to it through non-covalent interactions (like hydrogen bonds, ionic bonds, and hydrophobic interactions). This binding forms an antigen-antibody complex.

Procedure for preparing Antigen –Antibody complex

1- Preparation of Antigens and Antibodies:

- **Antigen Selection:** Choose the specific antigen.
- **Antibody Production:** Obtain or produce antibodies specific to the chosen antigen. This can involve immunizing animals (like rabbits or mice) .

2- Incubation:

- **Mixing:** Combine the antigen with the specific antibody in a suitable buffer solution. The concentration and volume will depend on the assay being performed.
- **Incubation Period:** Allow the mixture to incubate for a specified time to facilitate the binding of antibodies to the antigens, forming the antigen-antibody complex.

Types of Immunological Reactions:

- 1-Agglutination Reactions
- 2- Precipitation Reactions
- 3- ELISA Reactions
- 4- Radio-Immuno Assay (RIA)
- 5- Fluourescent Immune Reactions.
- 6- Western Blotting.

Antigen –Antibody Detection

Refers to the process of identifying the presence of a specific antigen (a foreign substance, like a virus or bacteria) or antibody (the protein produced by the immune system in response to an antigen) in a sample.

Application of Antigen –Antibody Detection

- 1- Disease Diagnosis:** Identifying infections (viral, bacterial, or parasitic) and autoimmune diseases.
- 2- Blood Typing:** Determining blood groups based on antigen-antibody interactions.
- 3- Vaccine Development:** Assessing immune responses to vaccines by measuring specific antibodies.

Rapid Antigen and Antibody Test

Example: COVID-19 Rapid Antigen and Antibody Test

- **Purpose:** Detects antibodies (IgM and IgG) in the blood, indicating a past infection or immune response to the virus.
- **Procedure:** A small blood sample (usually a finger stick) is collected, and results are provided in about 10-20 minutes.

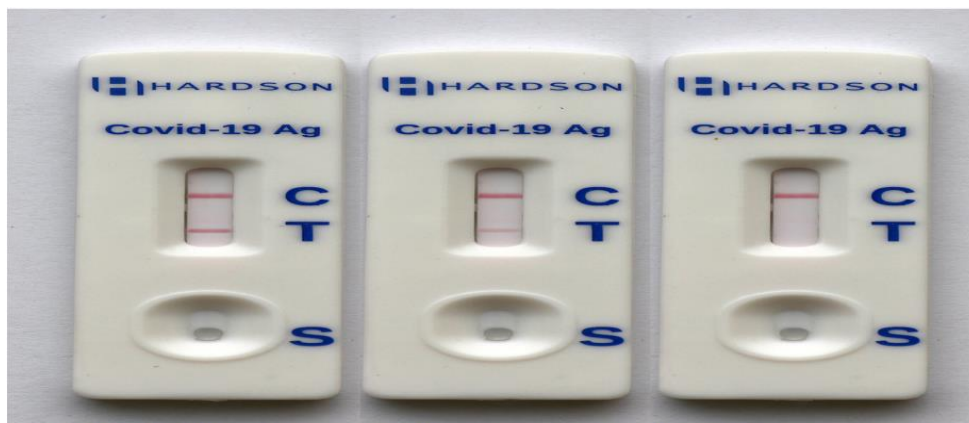
Component of Rapid antigen and antibody Test

Rapid Antigen Test Components:

- 1. Test Device:** Usually a lateral flow device that contains a reaction zone.
- 2. Sample Pad:** Where the sample (e.g., nasal swab) is applied.
- 3. Conjugate Pad:** Contains labeled antibodies that bind to the target antigen, usually a colored particle (like gold nanoparticles).
- 4. Reaction Zone:** Area where the antigen-antibody reaction occurs; often includes immobilized antibodies specific to the target antigen.
- 5. Control Line:** A line that appears regardless of the test result, ensuring the test has functioned properly.
- 6. Buffer Solution:** Used to facilitate the movement of the sample and reactions through the device.

Rapid Antibody Test Components:

1. **Test Device:** Similar to the antigen test, usually a lateral flow device.
2. **Sample Pad:** Area for applying serum, plasma, or whole blood.
3. **Conjugate Pad:** Contains antigens that react with the antibodies in the sample, usually labeled for visualization.
4. **Reaction Zone:** Contains immobilized antigens that capture the antibodies if they are present.
5. **Control Line:** Indicates whether the test has worked correctly.
6. **Buffer Solution:** Helps in the migration of the sample and promotes reactions



From left to right: Strong positive sample, weak positive sample, negative sample.

Advantages & Limitations

- **Advantages:**
 - Rapid results, especially with lateral flow assays.
 - Sensitive and specific for certain diseases.
 - Can be used for both qualitative and quantitative analysis.
- **Limitations:**
 - False positives/negatives can occur due to cross-reactivity or timing of sample collection (e.g., antibody levels might not yet be detectable early in an infection).
 - Some tests may require confirmation with other diagnostic methods (like PCR for viral infections).