

Specimens and Collections, Preparation of Slides and Models for Testing

Types of Specimens

1. **Human Tissue Samples:** Skin, muscle, bone, organs, etc.
2. **Cell Cultures:** Primary cells, cell lines, stem cells.
3. **Body Fluids:** Blood, urine, cerebrospinal fluid, etc.
4. **Microbial Samples:** Bacteria, fungi, viruses, etc.
5. **Animal Models:** For testing and simulation.

Human Tissue Samples in Biomedical Engineering

Human tissue samples play a crucial role in biomedical engineering, especially in areas like diagnostics, medical device development, tissue engineering, and regenerative medicine. Understanding how to collect, handle, and analyze these samples is fundamental for students pursuing biomedical engineering.

I. Overview of Human Tissue Samples

Human tissue samples are biological specimens taken from human bodies for research, diagnostic, and therapeutic purposes. These samples help in studying the structure, function, and disease processes of various organs and tissues. Tissue samples can be collected through a variety of methods, each with its own protocols depending on the nature of the sample and the purpose of the study.

A. Types of Human Tissue Samples

1. **Epithelial Tissue:**
 - Found in the skin, lining of organs, and glands.
 - Examples: Skin biopsies, mucosal samples from gastrointestinal tract.

2. Connective Tissue:

- Supports, binds, and protects other tissues and organs.
- Examples: Bone biopsies, cartilage, adipose tissue, tendons, and ligaments.

3. Muscle Tissue:

- Responsible for movement and contraction.
- Examples: Skeletal muscle biopsies, cardiac tissue (from heart surgeries), smooth muscle samples.

4. Nervous Tissue:

- Transmits electrical signals throughout the body.
- Examples: Brain biopsies, spinal cord samples, peripheral nerve tissue.

5. Blood and Lymphatic Tissue:

- Cells and components involved in immune function and nutrient transport.
- Examples: Blood samples, lymph node biopsies.

6. Specialized Tissues:

- Includes tissues such as endocrine glands, reproductive organs, and sensory tissues.
- Examples: Thyroid biopsies, testicular samples, retinal tissue.

II. Methods of Collecting Human Tissue Samples

The method of collection largely depends on the type of tissue, the intended use of the sample, and ethical considerations. The primary methods for obtaining human tissue samples:

A. Non-invasive Methods

1. Skin Biopsy (Punch or Shave Biopsy):

- A small section of skin is removed to examine for diseases such as melanoma, infections, or autoimmune conditions.

2. Blood Collection:

- Blood samples are taken via venipuncture (usually from the arm) or capillary sampling (from a fingertip).
- Used for diagnostic testing and genetic analysis.

3. Urine Collection:

- Often used to study kidney function, urinary tract infections, and metabolic disorders.

4. Saliva Sampling:

- Non-invasive and often used for genetic testing or hormone level monitoring.

5. Sweat or Exhaled Breath:

- Emerging methods for non-invasive testing, especially in detecting respiratory diseases like asthma or cystic fibrosis.

B. Invasive Methods

1. Needle Biopsy:

- A fine needle is used to extract tissue from organs like the liver, kidney, or prostate.
- Used for conditions like cancer, infections, or organ rejection in transplant patients.

2. Endoscopy:

- A flexible tube with a camera and tools for taking tissue samples from internal organs such as the colon, lungs, or stomach.
- Common for gastrointestinal biopsies or lung tissue for cancer diagnosis.

3. Surgical Biopsy:

- Tissue is removed during surgery for diagnosis, often in cases of cancer.
- May involve partial removal of a tumor or organ to understand the extent of disease.

4. Aspirates (Fine Needle Aspiration):

- Tissue or fluid is drawn into a syringe using a thin needle. Often used for detecting cancers or infections in lymph nodes, breast tissue, or thyroid.