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OF

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY

(PHARMACY INSTITUTE)

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PRESENTS

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Messages from the desk of the Editor

DR. R. MAZUMDER
PROFESSOR AND DEAN
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It gives us immense joy and satisfaction to introduce the second issue of 2023 of the magazine 'Pharma Innovations'. I hope you enjoy reading the magazine which will be beneficial to enrich your knowledge in Pharmacy, medicines, and health. As always this issue is also an attempt to bring out the knowledge concealed within the students and faculty. Before looking ahead, however, I would like to offer a word of thanks to our readers, our contributors, and our editorial board for their support of the journal and its mission I hope you enjoy reading this issue as much as we have enjoyed making it.

Messages from the desk of the Associate Editor

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On behalf of the editorial board members, it is announced that the second issue of 2023 “Pharma Innovations”. has been published. “Pharma Innovations” is a magazine that sturdily focuses on inspiring the faculty and students to gain knowledge and actively driving the mind toward research in health, medicines, and pharmacy. This unprejudiced attitude toward the scope of the magazine allows the reader to have a divergent and convergent aspect on different topics. Enables budding researchers to think in a rational way to make the scientific pavement.

DR. SWARUPANJALI PADHI
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GREATER NOIDA

FACULTY FORUM

APPLICATION OF CARBON DOTS IN DRUG DELIVERY SYSTEM

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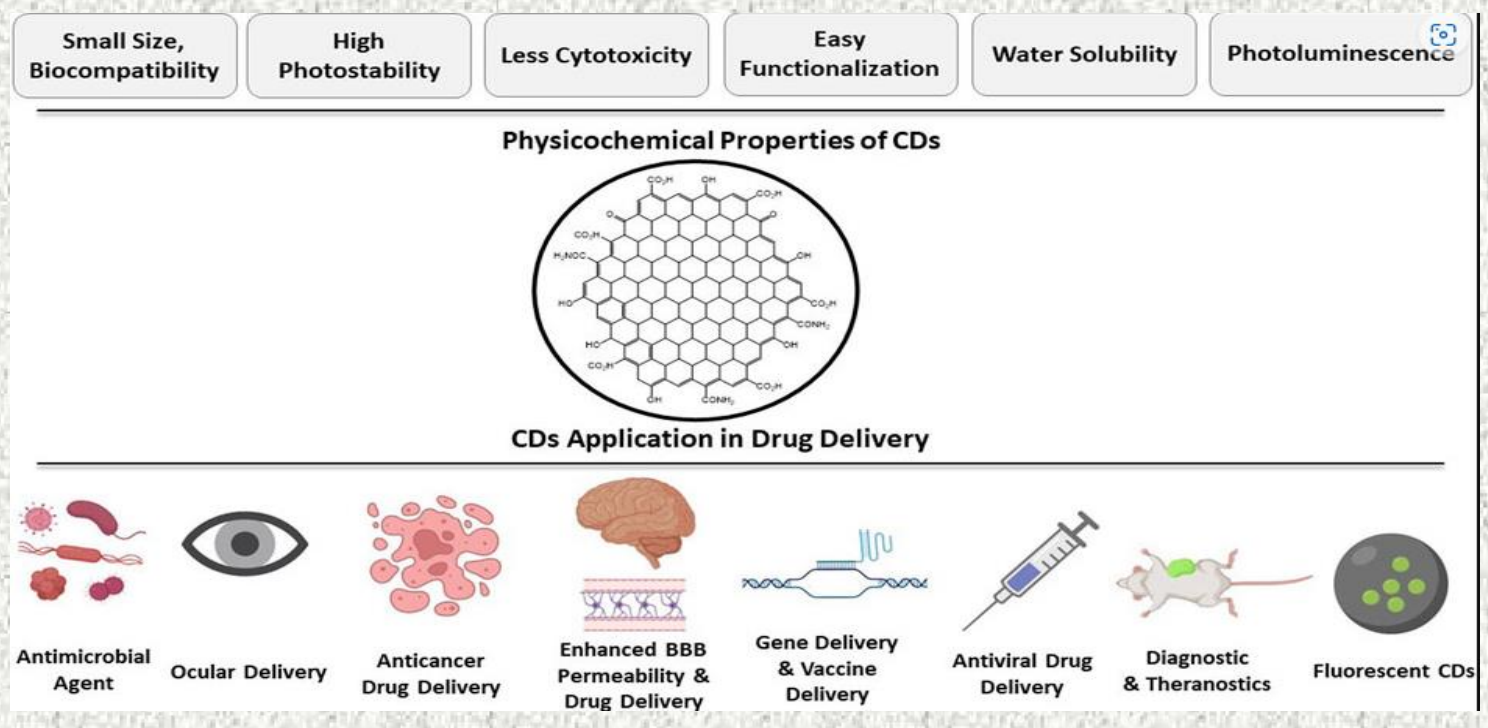
Carbon dots (CDs), which were first discovered in 2004 by Walter Scrivens and his colleagues, have several advantageous properties, including better water solubility, non-blinking photoluminescence, easy functionalization, less cytotoxicity, high chemical inertness, and easy photostability. Due to these characteristics, CDs can be used in a variety of industries, including bioimaging, optoelectronics, and medication delivery. CDs are primarily employed in pharmaceuticals as a nanomaterial for gene delivery and medication delivery in a variety of diseases, including cancer, neurological disorders, ocular diseases, infectious diseases, and infections. To improve their water solubility and enable conjugation with organic, inorganic, and biomolecules for a variety of applications, CDs have functional groups on their surfaces.



Functional groups on the surface of CDs, particularly amino, carboxyl, and hydroxyl groups, aid in additional alterations that enhance their optical characteristics, target ability, biocompatibility, and sensitivity and selectivity

APPLICATION OF CARBON DOTS IN DRUG DELIVERY SYSTEM

The manner in which CDs interact with the analytes determines the way they ought to be applied. Analyte-CD interaction either increases fluorescence by blocking the quenching effect or decreases fluorescence by quenching. Static quenching, energy transfer, dynamic quenching, photoinduced electron transfer, and inner filter action make up the CD's quenching mechanism. Dexter energy transmission, fluorescence resonance energy transfer, and static energy transfer are other forms of energy transfer.

For specific medicinal compounds, CDs offer the benefit of allowing surface functionality to be chosen through electrostatic interaction. Different kinds of CDs have been created to date for a variety of uses, including medication delivery, gene delivery, therapeutic drug delivery, chemical sensing, biosensing, bioimaging, electrolysis, etc. Additionally, researchers found that CDs emit in the near-infrared (NIR) spectral range when stimulated by NIR light, which broadens the spectrum of applications for CDs in photoacoustic imaging, bioimaging, drug administration, and anticancer therapy. According to researchers, CDs have excellent photostability and fluorescent quality that make them useful as probes in the analytical sector. In order to distinguish between cancerous and normal cells using bioimaging, green and red-emitting CDs have recently been created.

STUDENTS' FORUM

3D PRINTING REVOLUTIONIZES PHARMACY

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3D printing is transforming the pharmaceutical industry, offering a more personalized and precise approach to medication. Imagine printing pills with customized dosages, shapes, and release rates, tailored to individual patient needs. This is the future that 3D printing promises, and it's rapidly becoming a reality.

Benefits of 3D Printing in Pharmacy

- Personalized medicine: 3D printing allows for the creation of medications with precise dosages and tailored release profiles. This can be especially beneficial for children, the elderly, and patients with complex medical conditions. For example, 3D printed pills can be designed to dissolve slowly in the stomach, reducing the risk of side effects.
- Improved treatment adherence: 3D printing can make medications more appealing and easier to take. For example, pills can be printed in fun shapes or colors, or embedded with dissolvable flavorings. This can be especially helpful for children who struggle to swallow traditional tablets.
- Reduced medication waste: 3D printing allows for the production of medications on demand, eliminating the need for large-scale manufacturing and the associated waste. This can be beneficial for both the environment and pharmaceutical companies.
- Increased accessibility to medication: 3D printing technology could make it possible to produce medications in remote areas or for rare diseases, where traditional manufacturing is not feasible. This could improve access to life-saving treatments for millions of people worldwide.

3D PRINTING REVOLUTIONIZES PHARMACY

Applications of 3d printing in pharmacy:

- Printing tablets and capsules with customized dosages and release profiles
- Creating implants and prosthetics with personalized designs
- Developing transdermal patches for controlled drug delivery
- Printing medical devices, such as syringes and inhalers
- Producing biocompatible scaffolds for tissue engineering

Challenges and future of 3d printing in pharmacy

Despite the many benefits, there are still some challenges that need to be addressed before 3D printing becomes widely adopted in the pharmaceutical industry. These challenges include:

- Regulatory hurdles: 3D-printed medications need to be rigorously tested and approved by regulatory agencies before they can be used in patients.
- Cost of technology: 3D printers are still relatively expensive, which could limit their adoption by pharmacies and patients.
- Drug compatibility: Not all drugs are suitable for 3D printing, as some may degrade or interact with the printing materials.

3D PRINTING REVOLUTIONIZES PHARMACY

However, the potential benefits of 3D printing are so significant that researchers and pharmaceutical companies are working hard to overcome these challenges. With continued investment and development, 3D printing is poised to revolutionize the way we develop, manufacture, and deliver medications. The future of 3D printing in pharmacy is bright. This technology has the potential to improve the lives of millions of people by providing more effective, personalized, and accessible medications. As the technology continues to evolve, we can expect to see even more innovative applications of 3D printing in the years to come.

REVOLUTIONIZING PHARMACY: THE ROLE OF IONIC LIQUIDS IN DRUG DEVELOPMENT

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Ionic liquids, a unique class of solvents composed entirely of ions, have emerged as a game-changer in the field of pharmacy. These versatile substances, which remain liquid at room temperature, offer a range of advantages that have sparked interest in their application within pharmaceutical research and development.

One of the key benefits of ionic liquids lies in their ability to dissolve a wide variety of compounds, including poorly soluble drugs. This characteristic enhances drug delivery systems, allowing for increased bioavailability and improved therapeutic efficacy. By employing ionic liquids as solvents, pharmaceutical scientists can overcome challenges associated with the solubility of certain drug compounds, paving the way for more effective medications.

Ionic liquids (ILs) have emerged as a versatile class of solvents with unique properties, making them promising candidates for various pharmaceutical applications. Unlike traditional solvents, ILs are composed entirely of ions and exhibit low melting points, high thermal stability, and negligible vapor pressure.

REVOLUTIONIZING PHARMACY: THE ROLE OF IONIC LIQUIDS IN DRUG DEVELOPMENT

1. **Solubility Enhancement:** One of the key challenges in pharmaceutical development is the poor solubility of certain drug compounds. Ionic liquids have proven to be effective solubilizing agents for poorly soluble drugs.

2. **Drug Delivery Systems:** Ionic liquids play a crucial role in the design and development of advanced drug delivery systems. They can be incorporated into various drug carriers, such as liposomes, nanoparticles, and microcapsules, to improve drug stability and release kinetics.

3. **Green Chemistry in Pharmaceutical Manufacturing:** Ionic liquids contribute to the principles of green chemistry by minimizing environmental impact in pharmaceutical manufacturing processes. Their non-volatile nature and ability to be recycled make them eco-friendly alternatives to traditional solvents.

4. **Biocompatibility and Safety:** The biocompatibility of ionic liquids is a critical factor in pharmaceutical applications. Many ILs exhibit low toxicity, and researchers are actively exploring formulations that are safe for human use.

5. **Stabilization of Biomolecules:** Ionic liquids have demonstrated the ability to stabilize biomolecules, such as proteins and enzymes, which are integral components of many pharmaceutical formulations.

REVOLUTIONIZING PHARMACY: THE ROLE OF IONIC LIQUIDS IN DRUG DEVELOPMENT

6. Ionic liquids are known for their tunable properties. Researchers can modify the chemical structure of these liquids to achieve specific characteristics, such as viscosity and conductivity.

In conclusion, ionic liquids have emerged as a promising frontier in pharmacy, offering solutions to longstanding challenges in drug development. From improving solubility and bioavailability to enabling sustainable manufacturing processes, the versatile nature of these solvents has positioned them as key players in shaping the future of pharmaceutical innovation. As research progresses, the integration of ionic liquids is likely to become increasingly prevalent, revolutionizing the landscape of pharmacy and ultimately leading to the creation of safer, more effective medications.

REVIEW ON GEL CHROMATOGRAPHY

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Gel chromatography, also known as size exclusion chromatography (SEC) or gel filtration chromatography, stands as a cornerstone in the realm of chromatographic techniques, particularly in the fields of biochemistry and molecular biology. With its fundamental principle of separating molecules based on size and shape, gel chromatography offers a versatile and gentle approach to the purification and analysis of macromolecules. Gel chromatography is also known as gel permeation chromatography (GPC). Size exclusion chromatography, Gel filtration, Molecular- sieve chromatography. This is a chromatographic technique that separates, dissolved molecules based on their size by pumping them through specialized columns containing a microporous packaging material (gel). It is one of the effective methods used to isolate and analyze bio-macromolecular substances. The stationary phase consists of beads containing pores that span a relatively narrow size range. When the gel is packed into a column and percolated with a solvent, it permits the large molecular weight components to pass faster without penetration of pores (totally excluded). Smaller molecules spend more time inside the beads and therefore are eluted later (after a larger volume of mobile phase has passed through the column).

REVIEW ON GEL CHROMATOGRAPHY

Principles and Components:

At its core, gel chromatography relies on a porous gel matrix, typically composed of materials like agarose or polyacrylamide. This matrix acts as a molecular sieve, allowing molecules to traverse through its pores. The size of the pores varies, creating a range that facilitates the separation of molecules based on their size. Smaller molecules enter the pores and take more extended paths, while larger molecules are excluded, taking shorter routes. This principle of molecular exclusion forms the basis for the separation mechanism in gel chromatography

Gel Matrix:

The choice of the gel matrix is crucial and depends on the size range of the molecules of interest. Agarose gels are often preferred for separating larger molecules, while polyacrylamide gels, due to their smaller pore sizes, are suitable for smaller molecules. The design of the gel matrix contributes significantly to the resolution and efficiency of the separation.

REVIEW ON GEL CHROMATOGRAPHY

Sample Loading and Elution

To initiate the chromatographic process, a sample containing a mixture of molecules is applied to the top of the gel column. The sample is then eluted through the column using a mobile phase, typically a buffer solution. As the molecules traverse the gel matrix, they follow different paths based on their sizes. Larger molecules navigate through the matrix more quickly and elute first, while smaller molecules take longer paths, eluting later. This systematic elution process results in distinct peaks in the chromatogram, each corresponding to a specific size range of molecules.

Detection Methods

Various detection methods can be employed to monitor the elution of molecules from the column. UV absorption, fluorescence, and refractive index detectors are commonly used. UV absorption is especially prevalent, as many biomolecules, including proteins and nucleic acids, absorb UV light. These detectors assist in identifying and quantifying the separated components, providing valuable information about the sample composition.

REVIEW ON GEL CHROMATOGRAPHY

Applications:

Gel chromatography finds widespread applications in biochemistry, molecular biology, and biotechnology. It serves as a reliable tool for the purification of proteins, nucleic acids, and other biomolecules. Its ability to separate molecules based on size makes it particularly valuable in characterizing the size distribution of macromolecules in a given sample. Researchers often utilize gel chromatography in the final stages of purification processes to achieve high-purity samples for downstream applications.

Advantages:

One of the key advantages of gel chromatography is its gentle nature. Unlike some other chromatographic techniques that may require harsh conditions, gel chromatography can be performed under mild conditions, preserving the structural and functional integrity of sensitive biomolecules. This makes it a preferred method for the purification of proteins and nucleic acids, which may be susceptible to denaturation or degradation under extreme conditions.

Additionally, gel chromatography is suitable for molecules with a broad range of sizes. Its versatility allows researchers to analyze and separate macromolecules with diverse molecular weights effectively. This adaptability is particularly valuable whendealing with complex biological samples containing a variety of molecules.

REVIEW ON GEL CHROMATOGRAPHY

Limitations

Despite its many advantages, gel chromatography has some limitations. One notable limitation is its lower resolution compared to high-performance liquid chromatography (HPLC) and other advanced separation techniques. This lower resolution may limit its ability to separate closely related molecules or complex mixtures with high precision.

Another consideration is the limited capacity of gel chromatography for large-scale purification. The potential for column overloading restricts its application in scenarios where large quantities of a particular biomolecule need to be purified.

Recent Advancements

Recent advancements in gel chromatography primarily focus on improving resolution and sensitivity. Innovative gel formulations and improved column designs aim to enhance the separation efficiency, allowing researchers to resolve closely related molecules more effectively. Additionally, efforts are directed towards the development of specialized gels for specific applications, such as the purification of certain classes of biomolecules. Technological improvements in detection methods have also contributed to the advancement of gel chromatography. Enhanced sensitivity and the integration of multiple detection techniques enable more comprehensive analyses, providing researchers with a deeper understanding of complex biological samples.

HIGHLIGHT ON BIOMATERIAL

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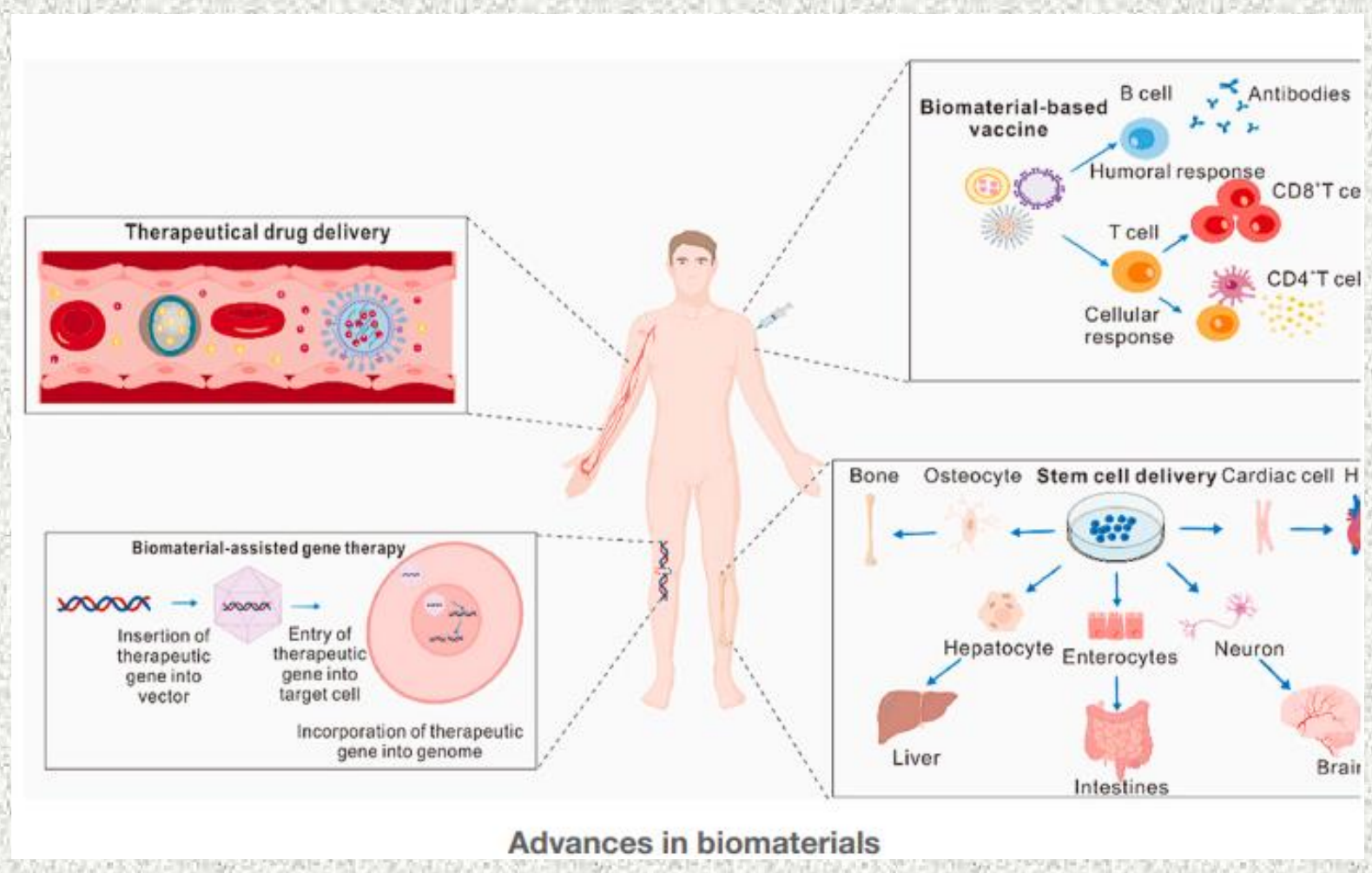
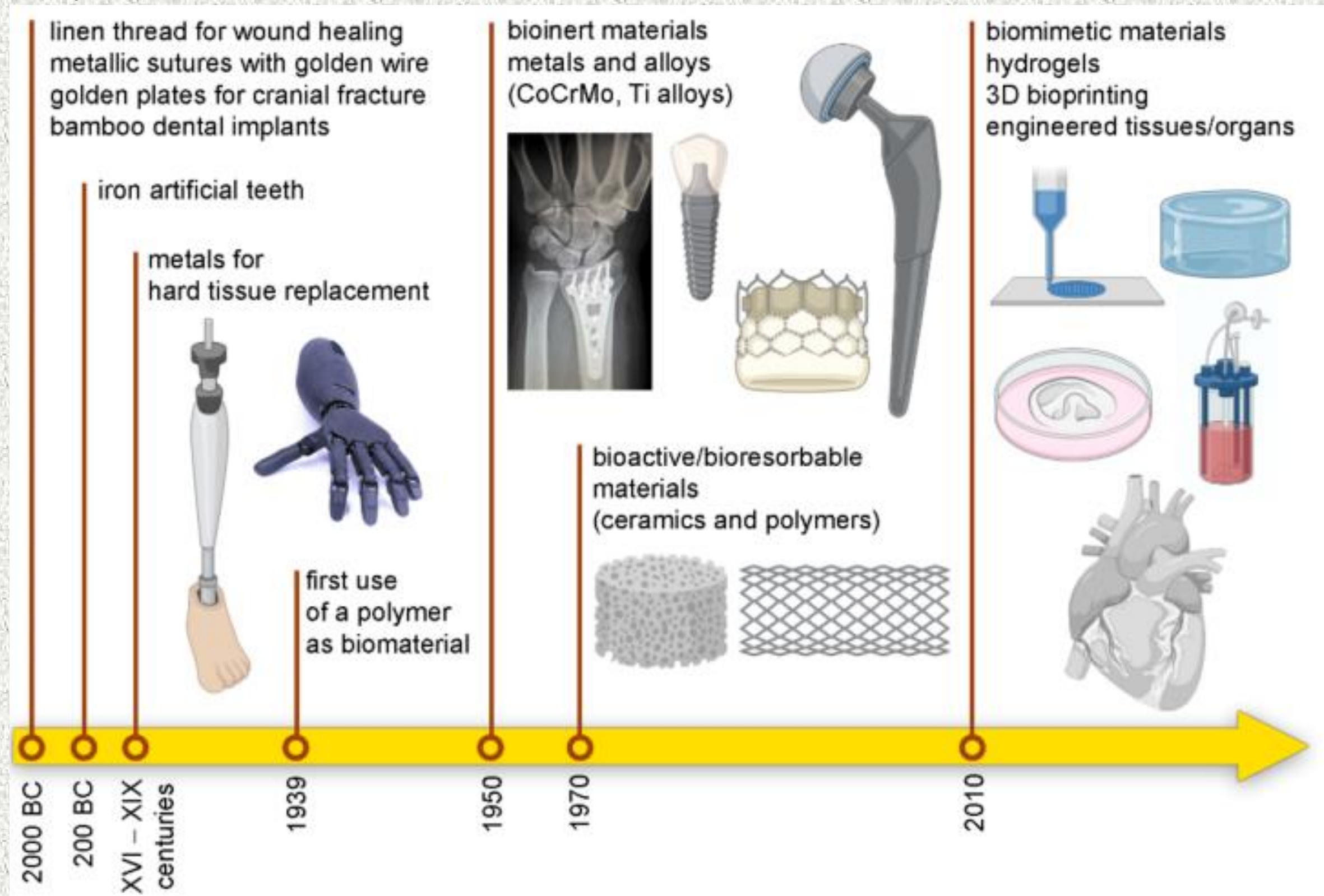
A biomaterial is a substance that has been engineered to interact with biological systems for a medical purpose, either a therapeutic (treat, augment, repair, or replace a tissue function of the body) or a diagnostic one. The corresponding field of study, called biomaterials science or biomaterials engineering, is about fifty years old. It has experienced steady and strong growth over its history, with many companies investing large amounts of money into the development of new products.



Advances in biomaterials

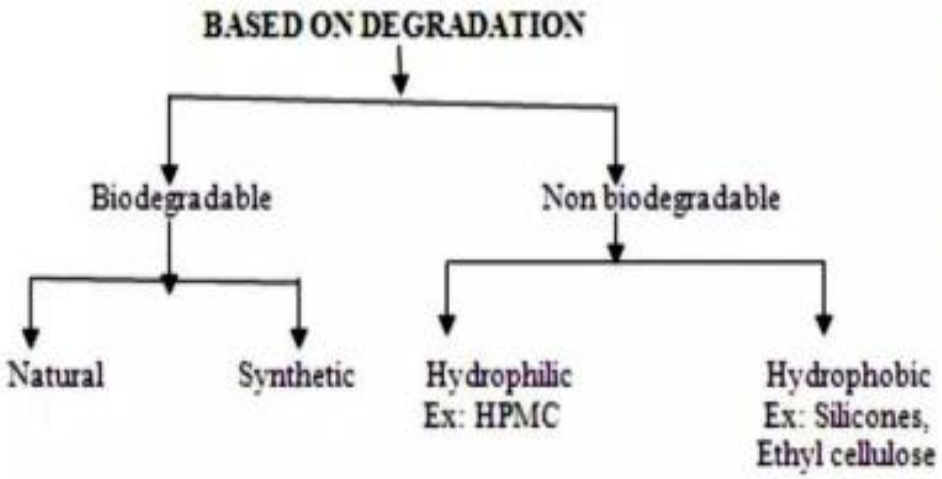
HIGHLIGHT ON BIOMATERIAL

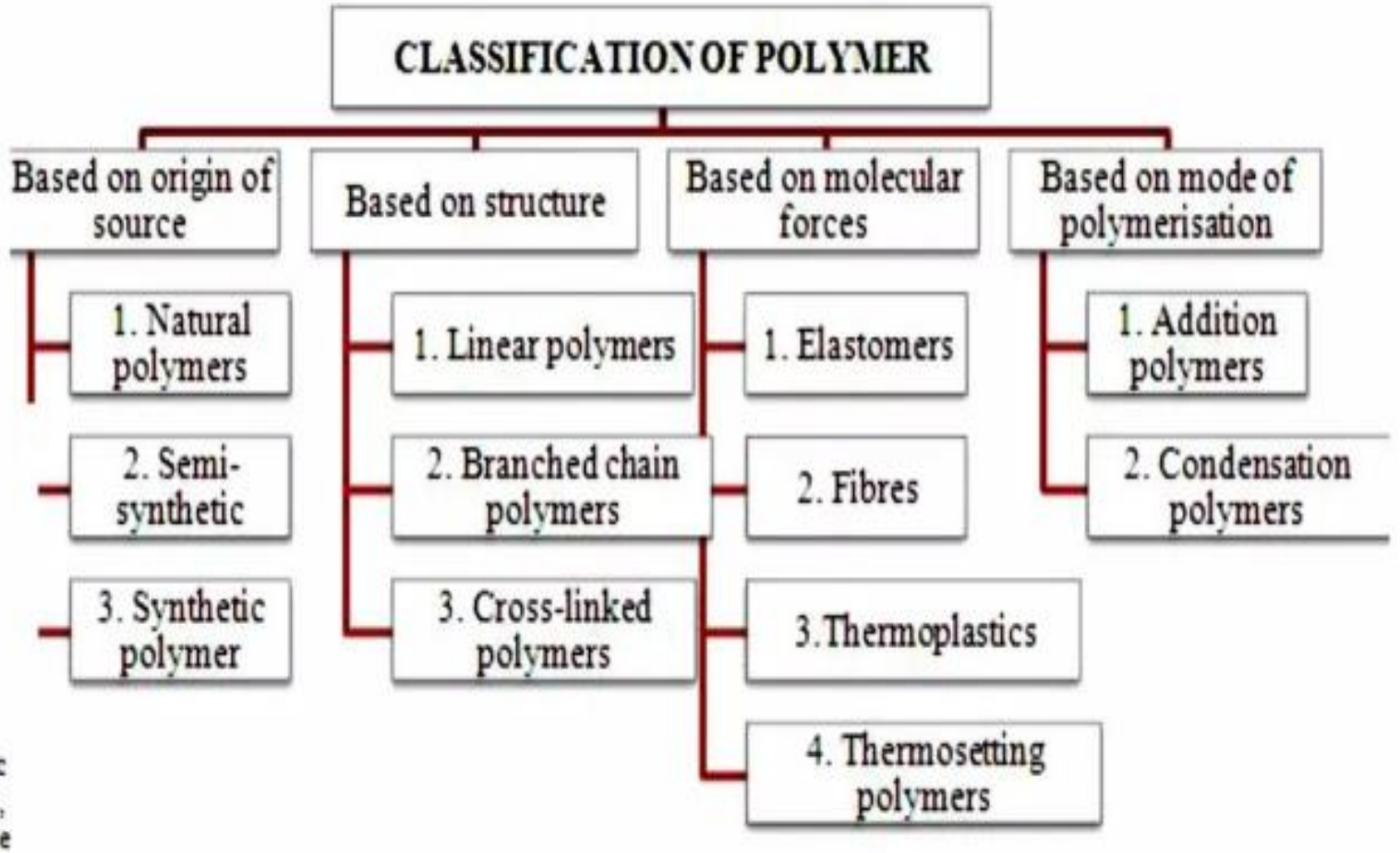
History of Biomaterials



HIGHLIGHT ON BIOMATERIAL

- Natural Polymer
- Synthetic Polymers
  - Biodegradable Polymer
  - Non-biodegradable Polymer





INSIGHT ON THE TECHNOLOGY USED TO ENHANCE SOLUBILITY

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The term 'Solubility' is defined as the maximum amount of solute that can be dissolved in a given amount of solvent to form a homogenous system at the specified temperature. The solubility of a drug is represented through various concentration expressions such as parts, percentage, molarity, molality, and mole fraction.

Importance of Solubility

• Therapeutic effectiveness of a drug depends on the bioavailability and ultimately upon the solubility of the drug molecule.

• It is an important parameter to achieve the desired concentration of drug in systemic circulation for pharmacological response to be shown.

• Any drug to be absorbed must be soluble or present in the form of an aqueous solution at the site of absorption.

Techniques of Solubility Enhancement

- Particle Size Reduction
  - ➢ Conventional methods
  - ➢ Micronization
  - ➢ Nanosuspension
- Hydrotropy
- Cosolvency
- Solubilization by Surfactants
- Solid Dispersion
  - ➢ The fusion method
  - ➢ The solvent evaporation method
  - ➢ Hot melt method
- pH adjustment
- High Pressure Homogenization
- Supercritical fluid recrystallization (SCF)
- Sonocrystallisation
- Complexation

INSIGHT ON THE TECHNOLOGY USED TO ENHANCE SOLUBILITY

1) Particle Size Reduction

• The solubility of a drug is related to drug particle size as a particle becomes smaller, the surface area increases, increase in solubility.

Techniques Of Particle Size Reduction

• Micronization

• Nanosuspension

• Micronization:

• **Micronization:** increases the dissolution rate of drugs through increased surface area; by decreasing particle size, it does not increase equilibrium solubility. Micronization of drugs is done by milling techniques using a jet mill, rotor-stator colloidal

•**Nanosuspension**: This technology is applied to poorly soluble drugs that are insoluble in both water and oils. A pharmaceutical nanosuspension is a biphasic system consisting of nano-sized drug particles stabilized by surfactants for either oral and topical use or parenteral use. The particle size distribution of the solid particles in nanosuspensions is usually less than one micron with an average particle size ranging between 200 and 600 nm.

2) Hydrotropy:

- Hydrotropy is a solubilization phenomenon whereby the addition of a large amount of a second solute increases the aqueous solubility of the existing solute.
- Concentrated aqueous hydrotropic solutions of sodium benzoate, sodium salicylate, urea, nicotinamide, sodium citrate, and sodium acetate have been observed to enhance the aqueous solubilities of many poorly water-soluble drugs.

INSIGHT ON THE TECHNOLOGY USED TO ENHANCE SOLUBILITY

3) Cosolvency

- The solubility of poorly soluble drugs in water can be increased by mixing it with some water- miscible solvent in which the drug is readily soluble. This process is known as co-solvency and the solvent used in combination is known as cosolvent.
- Co-solvent system works by reducing the interfacial tension between the aqueous solution and hydrophobic solute.
- The cosolvents have hydrogen acceptor or donor groups with a small hydrocarbon region. The hydrophobic hydrocarbon region usually interferes with the hydrogen bonding network of water which consequently reduces the intermolecular attraction of water while the hydrophilic hydrogen bonds ensure water solubility.

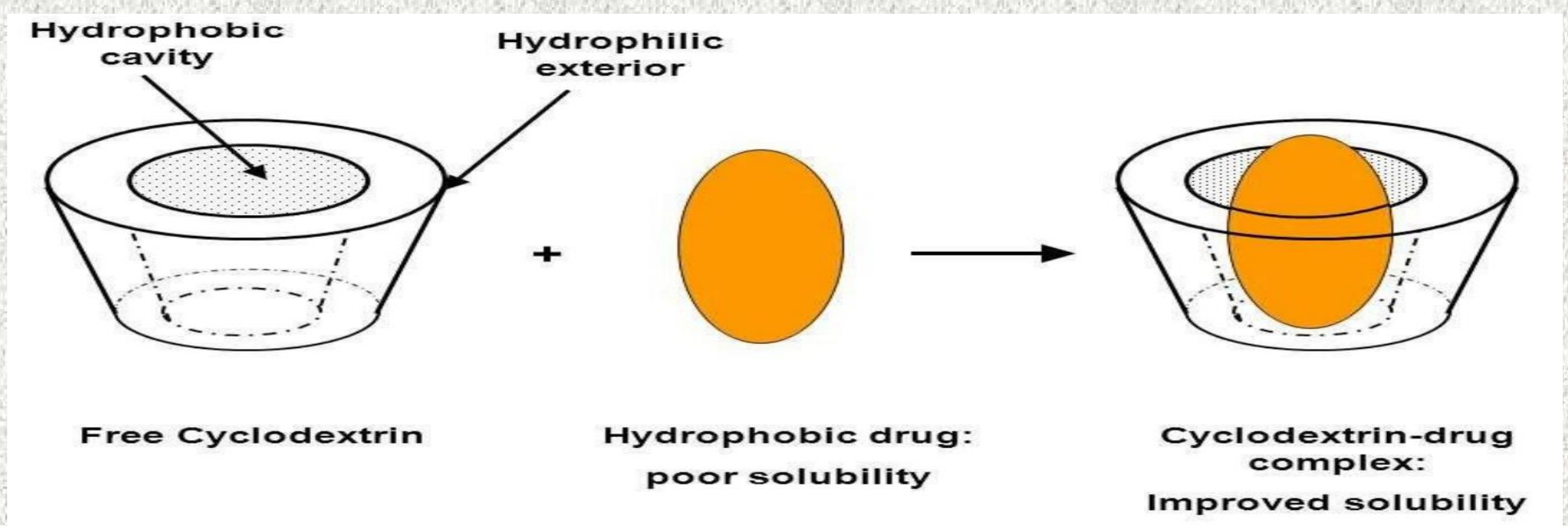
4) Solid Dispersion

Solid dispersion is defined as the dispersion of one or more active ingredients (hydrophobic) in an inert carrier (hydrophilic) a solid state it is prepared by: 1) The solvent evaporation method 2) the hot melt method 3) the fusion method

5) COMPLEXATION:

- Complexation of drugs with cyclodextrins has been used to enhance aqueous solubility and drug stability.
- Cyclodextrins of pharmaceutical relevance contain 6, 7, or 8 dextrose molecules (α, β, γ-cyclodextrin) bound in a 1,4-configuration to form rings of various diameters.
- The ring has a hydrophilic exterior and lipophilic core in which appropriately sized organic molecules can form non-covalent inclusion complexes resulting in increased aqueous solubility and chemical stability.

INSIGHT ON THE TECHNOLOGY USED TO ENHANCE SOLUBILITY



Application of Solubility

- Solubility represents a fundamental concept in fields of research such as chemistry, physics, food science, pharmaceutical, and biological sciences.
- The solubility of a substance becomes especially important in the pharmaceutical field because it often represents a major factor that controls the bioavailability of a drug substance
- Solubility of a substance is useful when separating mixtures.
- Moreover, solubility and solubility-related properties can also provide important information regarding the structure of drug substances, and in their range of possible intermolecular interactions.

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Stay Safe, Stay healthy,
and
Keep Learning