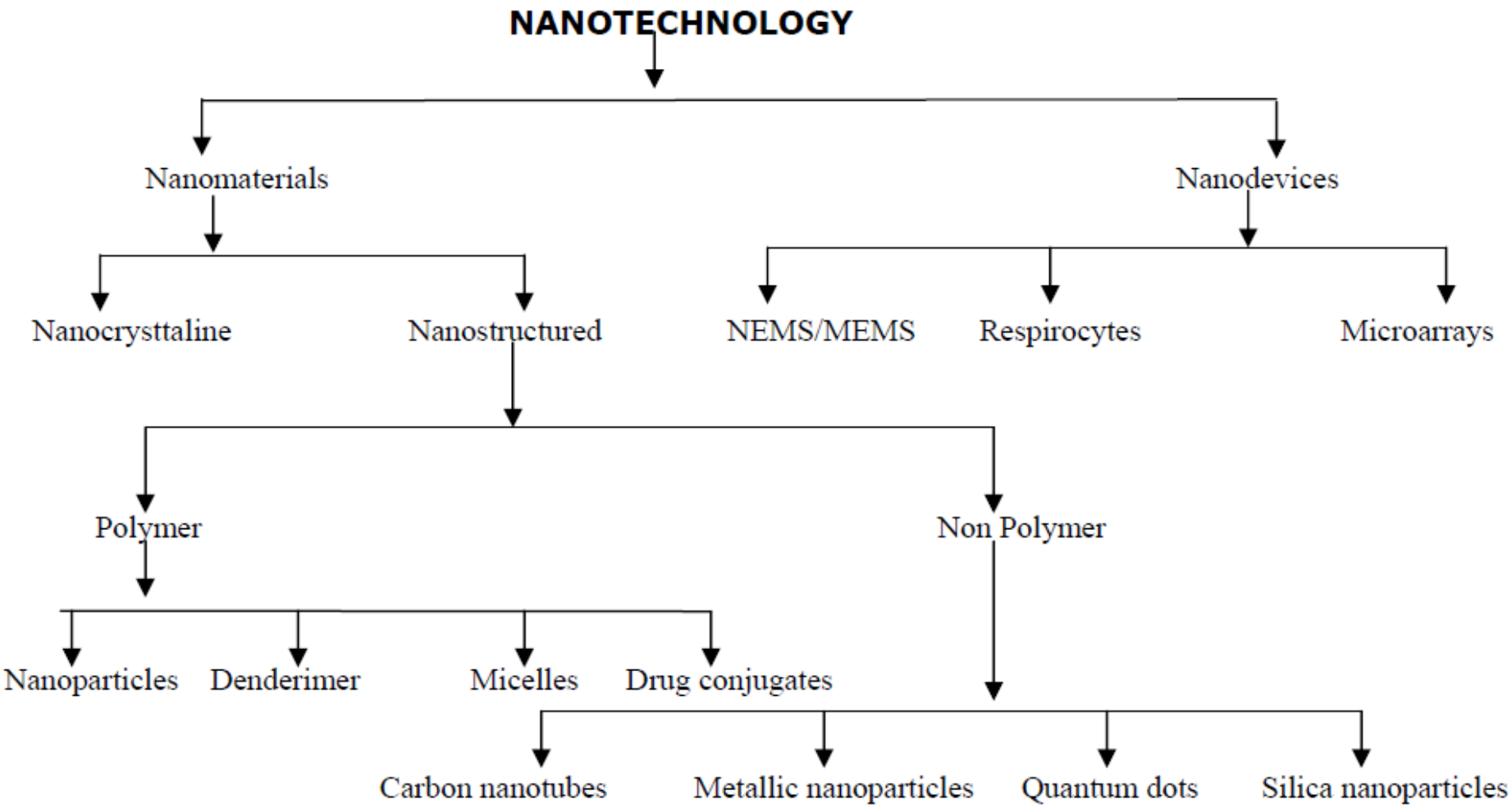
Nanopharmaceuticals: A New Perspective of Drug Delivery System

Nanotechnology benefits

- Increase drug targeting ability
- Reduce the dose needed
- Enhance oral bioavailability
- Decrease toxicity
- Enhance solubility
- Increase the stability of drug and formulation
- Increase surface area
- Enhance rate of dissolution
- Decrease drug resistance
- Increase patient compliance


NANOTECHNOLOGY
Nanomaterials
Nanodevices
Nanocrysttaline
Nanostructured
NEMS/MEMS
Respirocytes
Microarrays
Polymer
Non Polymer
Nanoparticles
Denderimer
Micelles
Drug conjugates
Carbon nanotubes
Metallic nanoparticles
Quantum dots
Silica nanoparticles

Drugs those can be delivered Nanostructurs

Drug	Type of Disease	Type of CNTs
Daunorubicin	Leukemia	SWCNTs
Doxorubicin	Lymphoma	SWCNTs
	Breast cancer	MWCNTs
Methotrexate	Breast cancer	MWCNs
Paclitaxel	Breast cancer	SWCNTs
Gemcitabine	Ovarian cancer	SWCNTs
Amphotericin B	Leishmania donovani (parasite)	Not specified
Carboplatin	Bladder cancer	Not specified

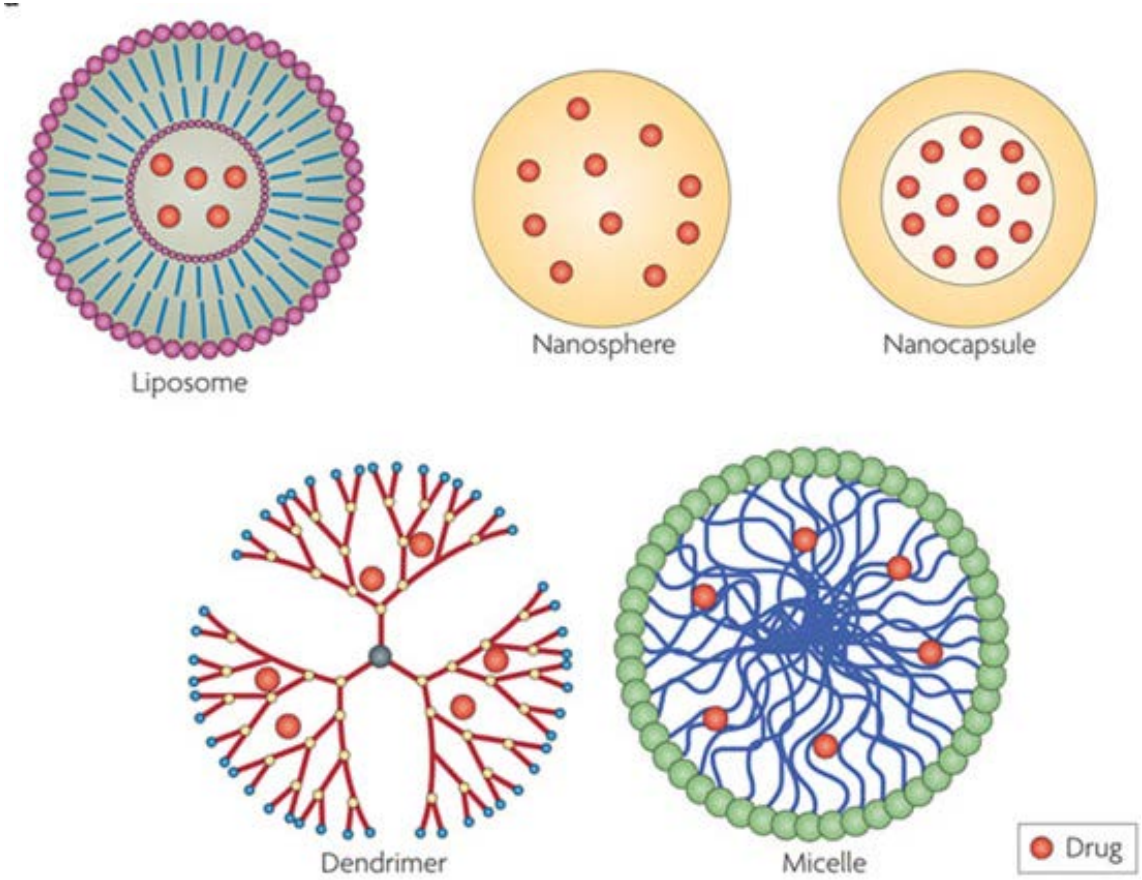
Drugs/ Therapeutics	Target cells/Diseases	Type of QDs	Efficacy
Saquinavir	HIV-1	Carboxyl-terminated QDs	High site-specificity and can cross BBB
Doxorubicin	Ovarian cancer	Mucin1- aptamer QD	Higher accumulation on target
5-Fluorouracil	Breast cancer	ZnS QDs	Targeting and controlled drug delivery to cancer cells.
Daunorubicin	Leukaemia	CdTe QDs	Enhanced drug uptake
Daunorubicin	Leukemia K562 cells	CdS QDs	Inhibit multidrug resistance

Therapeutics	Type of polymer/ Functionalization	Indication/ Activity	Effects
Paclitaxel	Aptamer- PEG-PLGA	Gliomas	Enhanced delivery
Cisplatin	Aptamer- PEG-PLGA	Prostate cancer	Higher efficiency
Vincristine + Verapamil	PLGA	Hepatocellular carcinoma	Reduced multidrug resistance
Doxorubicin+Cyclosporine A	PACA	Various cancers	Synergistic effect.
Zidovudine	Poly (isohexyl cyanate)	Targeting lymphoid tissue	Drug levels is four times higher
Zidovudine	Polyhexylcyano acrylate	Targeting lymphoid tissue	Higher Zidovudine levels in the body
Stavudine	Polybutylcyano acrylate (PBCA)	HIV/AIDS	8–20 times higher Permeability
Lamivudine	Methylmethacrylate-sulfopropylmethacrylate	HIV/AIDS	100% increased BBB permeability
Nerve growth factor (NGF)	Polysorbate 80 coated PBCA	Parkinsonism	Improved transport across the BBB
Amphotericin B	PLA-b-PEG	Neurodegenerative diseases	Improved transport across the BBB

Therapeutics	Type of Liposome	Indications
Topotecan+Vincristine	PEG-Liposome	Brain cancer
Irinotecan + Cisplatin	Mixture of two Liposomes	Small-cell lung cancer
siRNA + Doxorubicin	PEG-Liposome	MDR-breast cancer
Doxorubicin+Verapamil	Transferrin- (Tf-) conjugated PEG-Liposome	MDR-leukemia
Budesonide	Small molecular liposome	Asthma
Ketotifen	Small molecular liposome	Asthma
VEGF gene	Gene liposme	Pulmonary hypertension
Amiloride hydrochloride	Small molecular liposome	Cystic fibrosis
Tobramycin	Small molecular liposome	Pulmonary Infections
Interleukin-2	Protein liposome	Lung cancers
Insulin	Protein liposome	Diabetes

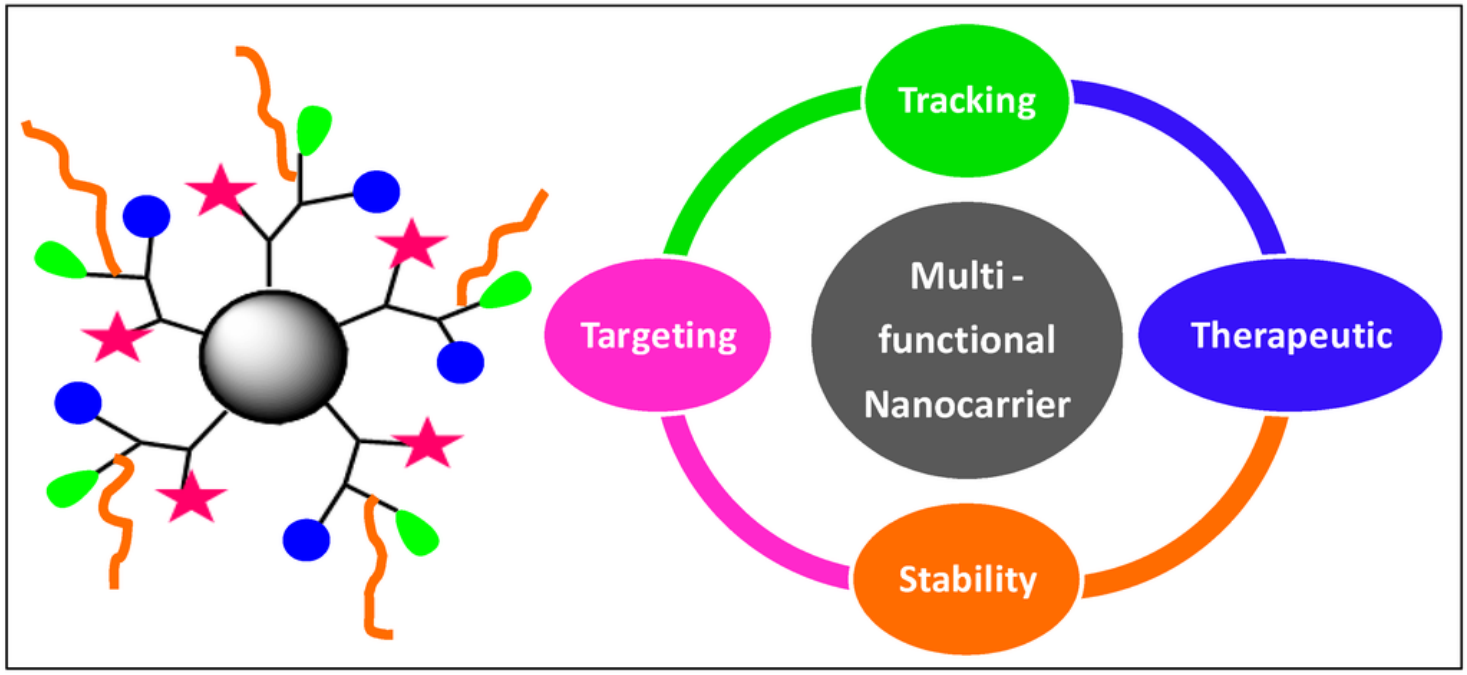
Drugs/Therapeutics	Type of Dendrimers/Conjugates	Target cells/ Indications/ Functions	Advantages/ Features
Efavirenz	Tuftsin-conjugated PPE dendrimers	HIV	Targeted delivery to macrophages
Lamivudine	Mannose-capped PPE dendrimers	HIV	Increased cellular uptake, reduced cytotoxicity
siRNA	Amino-terminated carbosilane dendrimers	Lymphocytes	Reduced HIV infection, in-vitro
Sulphated oligosaccharides	Polylysine dendrimers	HIV	Higher activity due to dendrimer product
Galactosylceramide analogues	Multivalent phosphorus-containing catanionic dendrimers	HIV-1	Higher stability and anti-viral property, lower toxicity
Doxorubicin	2,2 bis(hydroxymethyl) propanoic acid-based dendrimers	Colon carcinoma cells of rat	In vitro and in vivo, dendrimer product was ten times less toxic
SN38	G3.5 PAMAM dendrimers	Hepatic colorectal cancer cells	Increase oral bioavailability and decrease gastrointestinal toxicity
Boron	EGF-carrying PAMAM dendrimers	Neuron capture technology	Intratumoral injection or CED
EGFR siRNA	Dendriworms	Knockdown EGFR expression	IV or CED
Plasmid pEGFP-N2	Angiopep-carrying PEGylated PAMAM dendrimer G5.0	Encode green fluorescence protein	IV

Drug loaded NPs



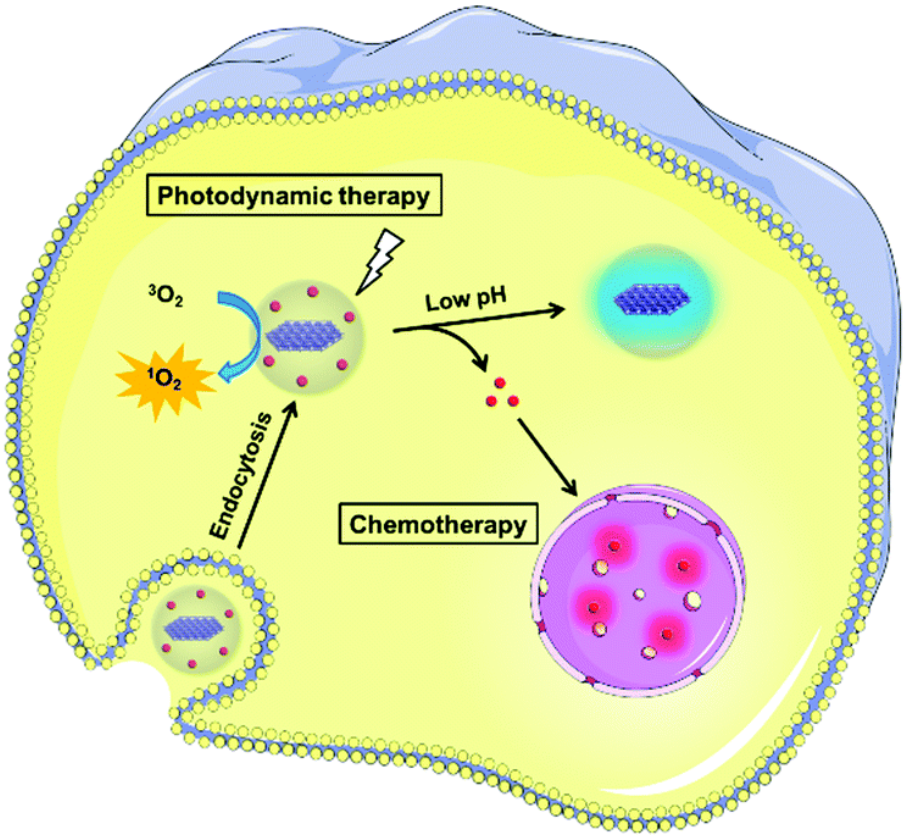
Engineering NPs

- Surface Functionalization
- Controlled Release
- Tissue-Targeting Design

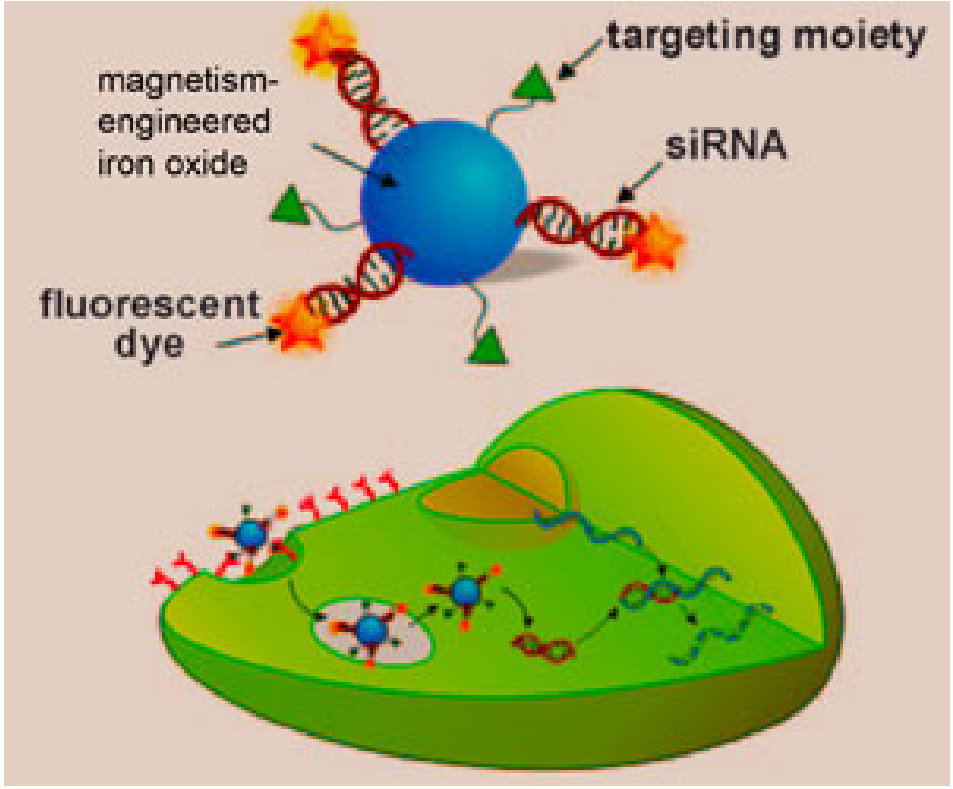


Combination NPs

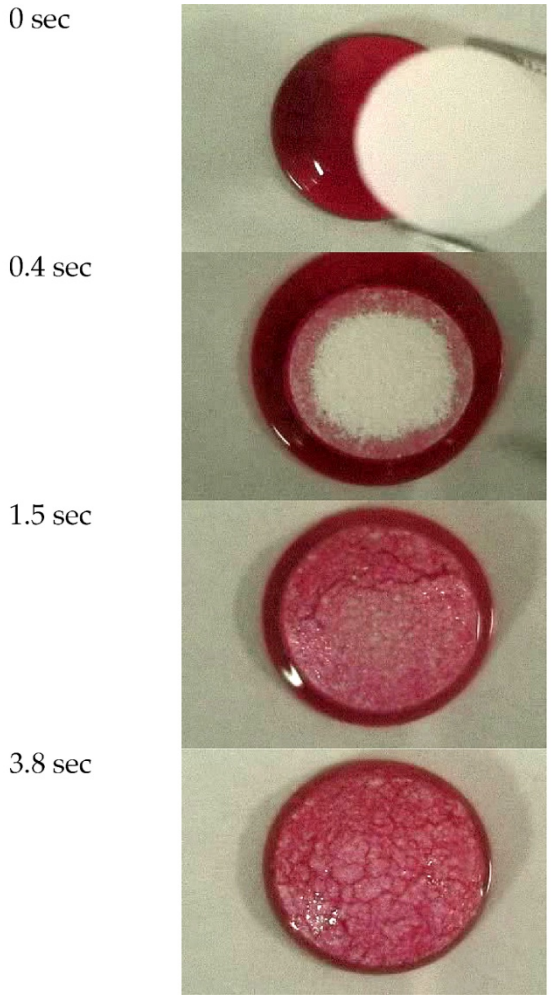
- Combined Therapy by Simultaneously Encapsulated Drugs.

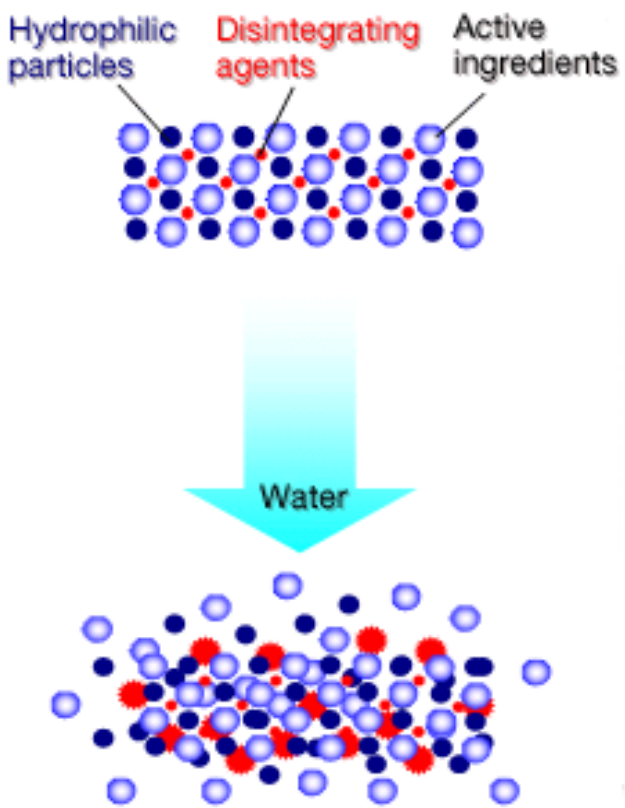


Combined Therapy by multifunctional NPs

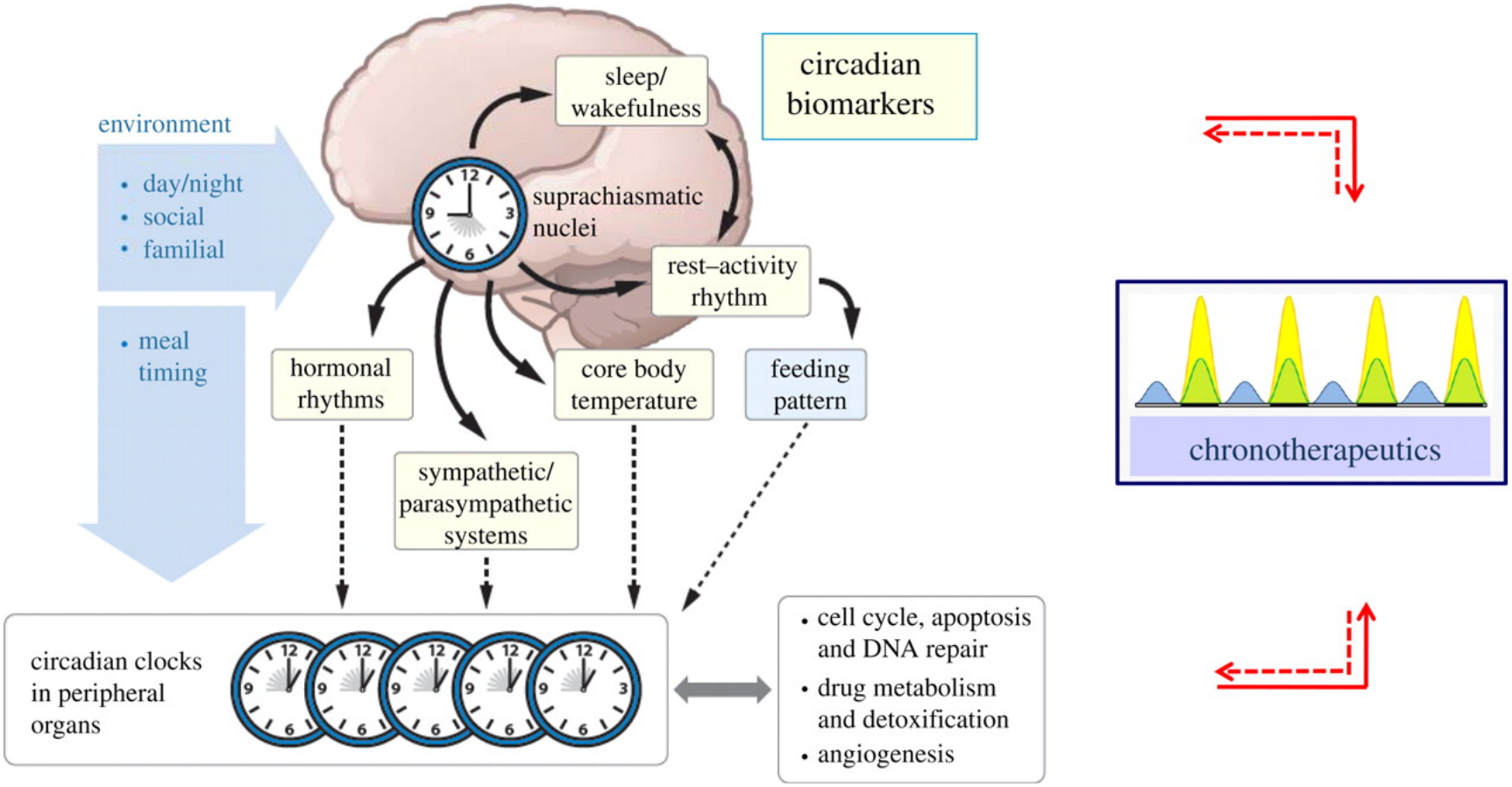


Fast disintegrating/dissolving tablets

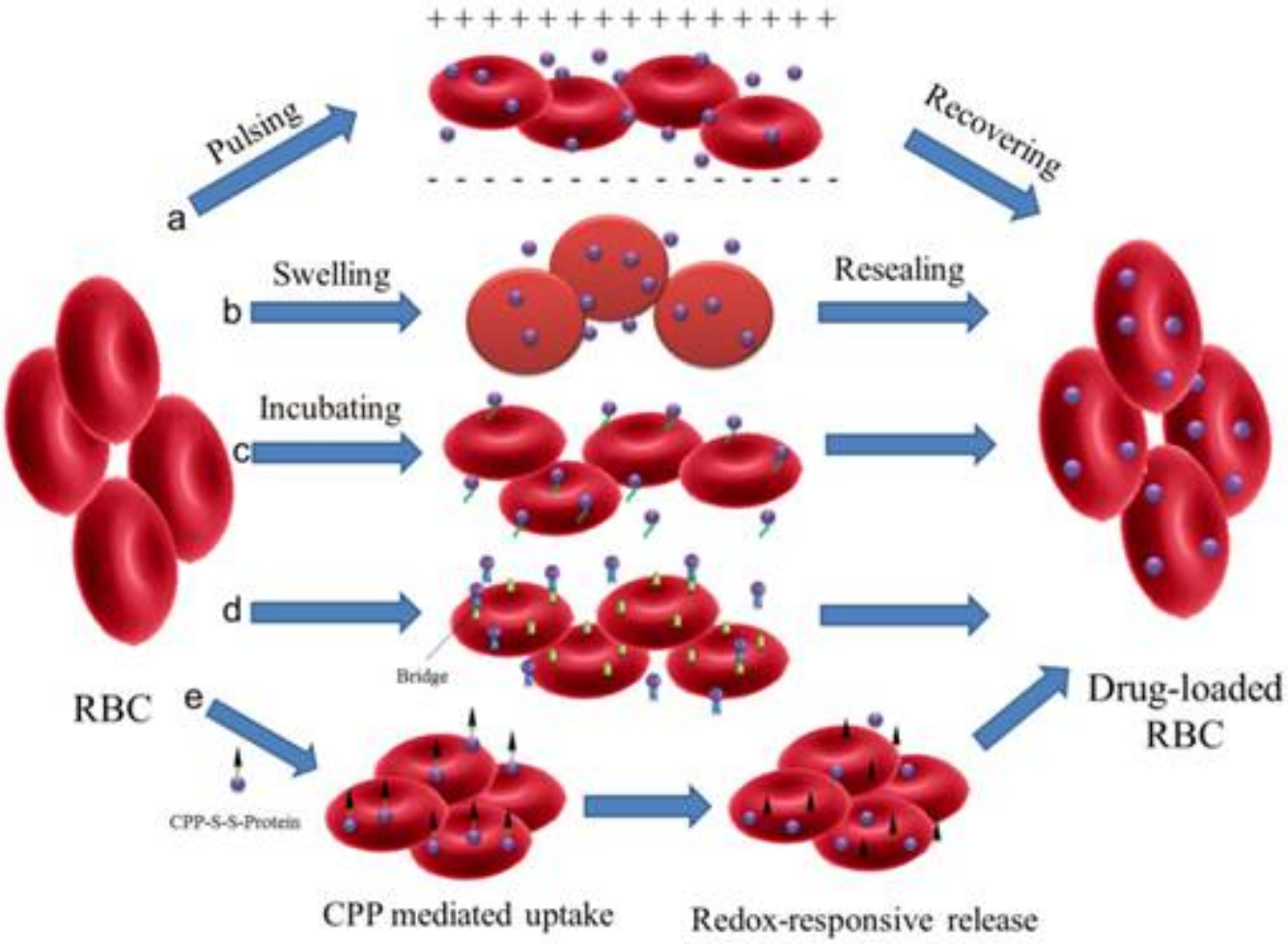




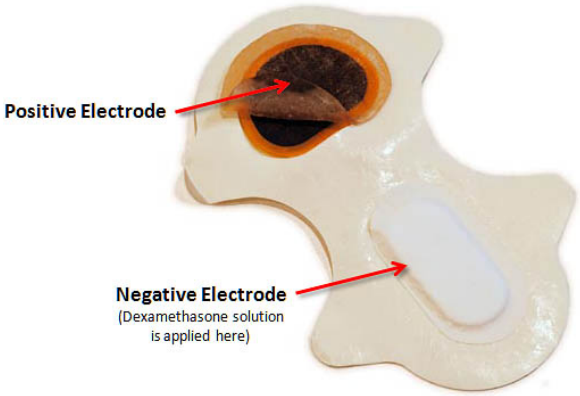
Chronotherapeutics

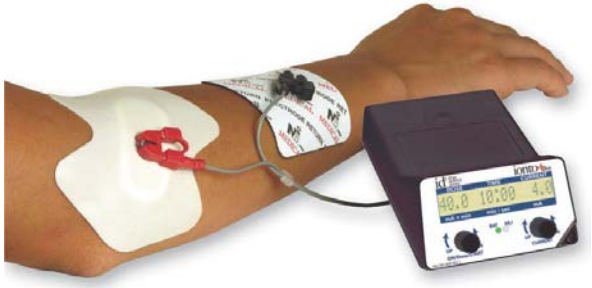


Drug loaded erythrocytes



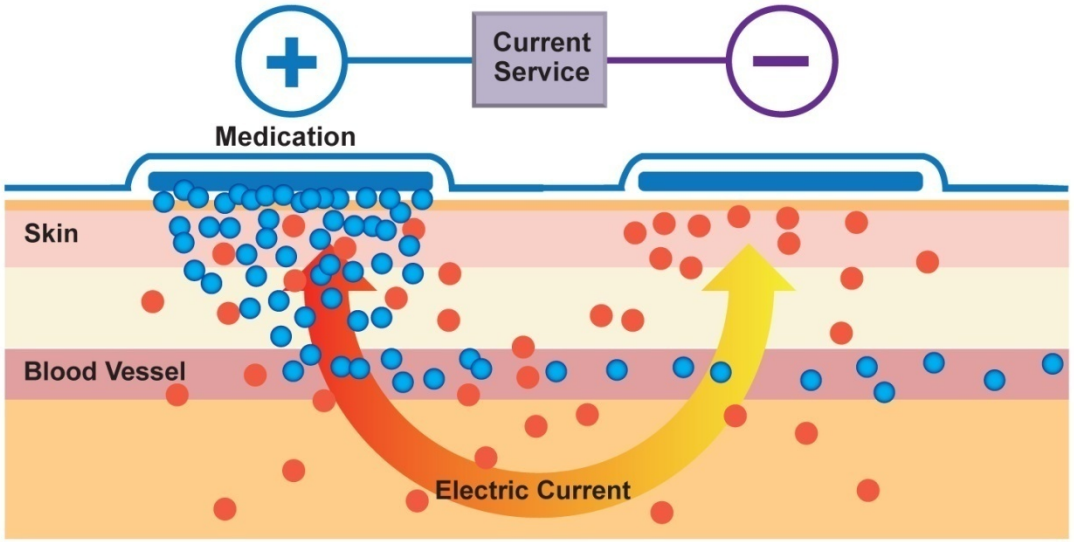
Iontophoresis and phonophoresis





Ionized drug (cation=positive ion)

Counter-ion <Cl^-, etc.> (anion=negative Ion)



Molecular imprinting technology

- The molecular imprinting technology has an enormous potential for creating satisfactory drug dosage forms.

- Molecular imprinting involve forming a pre-polymerization complex between the template molecules and functional monomers or functional oligomers (or polymers) with specific chemical structure designed to interact with the template either by covalent, non-covalent chemistry (self-assembly) or both.

- ✓ Rate programmed
- ✓ Activation modulate
- ✓ Feedback regulated

Thank you for your attention