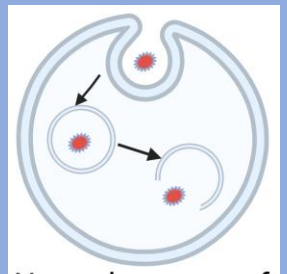
Zinc Selenide Quantum Dots as Intracellular Drug Delivery Vehicles

Team 11: Iman Ayaz[1], Angela Mamatas[1], Anjana Nair[1]
Advisors Dr. Wan Shih[1], Dr. Wei-Heng Shih[2]
1 School of Biomedical Engineering, Science and Health Systems 2 Materials Science and Engineering

Need:

- Chemotherapy → systemic treatment
- **Intracellular drug delivery** → direct diffusion into cell
- Current issue: **endosomal entrapment**

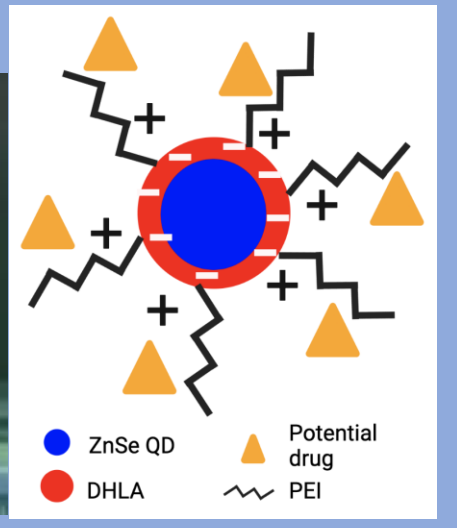

Normal process of endosomal escape

Objective: develop a nontoxic nanoparticle to deliver drug into cell without getting stuck in its endosome

Design Inputs: 1) Solution must be non-cytotoxic, i.e. cell viability ≥ 97 ± 2% & 2) Solution must have a positive charge (> 0mV) to enter cells

Solution:

- **Zinc Selenide** quantum dots (QDot) complexed with **polyethylenimine (PEI)**
  - Held together by electrostatic interactions
- **Innovation:** PEI breaks the endosomal entrapment
- **Why ZnSe QDot?** Non-toxic, successful bioimaging probe*



*bright → great for tracking

Verification:

Design Input	Test	Result
1	Trypan Blue Assay	95% cell viability (PASS)
2	Zetasizer count	9.17 ± 0.93 mV (PASS)

Future Plans & Impact:

- **Low dosage = less side effects** → betters their quality of life and the progression of their disease
  - **The drug costs are reduced** for patients
- Further work includes **optimizing the brightness** of the quantum dots for **better tracking**

Overview: Quantum dots complexed with PEI prove to be non-toxic drug delivery vehicles with the potential to break their endosomal entrapment due to their positive charge, encouraging further research.