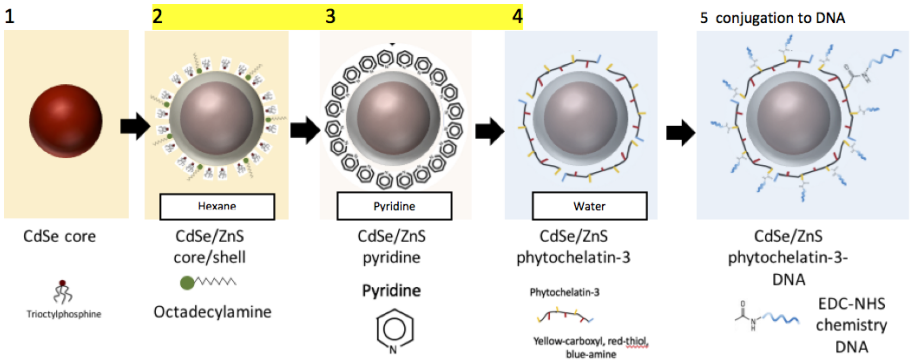
# Qdots--- Quantum Dots

**Quantum dots or qdots are a new breed of nonorganic nanocrystalline fluorescent probes**, which have recently caught the interest of many biologists and generated much hope, some hype, but also skepticism (for recent reviews, see for instance ref. [2, 3, 4]). A consensus has emerged concerning their superior photophysical properties, but mixed reports on their stability or compatibility with long-term live imaging might be attributed to the fact that there are currently almost as many quantum dots as there are reports about them. This diversity has multiple origins. First, qdots can be synthesized using different materials and protocols, leading to various final products. Second, qdots need to be solubilized in aqueous buffers using additional chemical steps. At this stage too, a vast number of solutions have been proposed and tested. **Finally, biological functionalization adds a third level of diversity---**




## Method of assembly which the body can impact the atomic size of QDots

**A number of different self-assembly techniques (bottom-up)** have been used to synthesize the QDs, **and they may be broadly subdivided into wet-chemical and vapor-phase methods** [22]: (a) wet-chemical methods mainly follow the conventional precipitation methods with careful control of parameters for a single solution or mixture of solutions. The precipitation process invariably involves both nucleation and limited growth of nanopar-ticles. Nucleation may be categorized as homogeneous,heterogeneous, or secondary nucleation [27]. Homoge-neous nucleation occurs when solute **atoms or molecules combine and reach a critical size without the assistanceof a pre-existing solid interface. Wet-chemical methodsare generally microemulsion, sol**

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gel [28-30], competitivereaction chemistry, hot-solution decomposition [31-33],sonic waves or microwaves [34], and electrochemistry.

**Quantum dots are nanosized semi-conductors that generate electron-hole pairs confined in all three dimensions (quantum confinement), and hence behave like giant molecules rather than bulk semiconductors**

Unfortunately, **most quantum dots contain highly toxic metals such as cadmium,** which tends **to be released when the quantum dots enter the cells or organisms.**

## Extremely toxic to the male testicles -like titanium and nano silver causes sterility

This was thought to be the main reason why CdSe/ZnSe quantum dots at nanomolar ($10^{-9}$mol) concentrations were toxic to *Daphnia magna,* but much less toxic than the equivalent concentration of cadmium ions [18]. **However, CdTe quantum dots coated with hydrophilic sodium thioglycolate caused disruption in a cultured monolayer of Caco-2 human intestinal cells and cell-death at 0.1 ppm, which was thought to be caused by the quantum dots**, rather than cadmium--- In a third study, **CdSe/ZnS quantum dots injected intravenously into mice caused marked vascular thrombosis in the lungs at 0.7 to 3.6 nanomol per mouse**, especially when the quantum dots had carboxylate surface groups [20]. **Three out of four mice injected at the higher concentration died immediately**.

## imagine that died immediately ~ silly billy has Qdot tech in his vaccines

**The injected quantum dots were mainly found in the lungs, liver and blood;** and the authors hypothesized that the quantum dots **activated the coagulation cascade through contact**. In fact, many kinds of nanoparticles enhance the formation of insoluble fibrous protein aggregates (amyloids) [21], which are associated with human diseases including Alzheimer's, Parkinson's and Creutzfeld-Jacob disease.

Researchers in Texas are reporting that quantum dots (QDs) — a product of the revolution in nanotechnology increasingly used in electronics, solar cells, and medical imaging devices — **may be toxic to cells under acidic or alkaline conditions**. Their study is the first to report on **how different pH levels may affect the safety of QDs.** -- In the new study, Pedro Alvarez, Shaily Mahendra, and colleagues note that **QDs are semiconductor**

**nanocrystals composed of a metal core** surrounded by a shell composed of zinc or **cadmium sulfide**. Scientists are increasingly concerned that these submicroscopic dots, about 1/50,000th the width of a human hair, **could decompose during normal use or after disposal. That decomposition could release toxic metals into the environment, posing a health risk to humans and animals**--To explore this concern, the scientists exposed two common types of bacteria that serve as models of cell toxicity and indicators of environmental health to QDs under different conditions of acidity and alkalinity. **At near neutral pH levels, bacteria exposed to QDs experienced decreased rates of growth**, but did not die.

## this would impact the intestinal tract and digestive system

**However, at moderately acidic or alkaline conditions, many of the QD-exposed bacteria died as QDs shells decomposed, releasing their content of toxic metals**. However, proteins and natural organic matter may be able to mitigate toxicity by complexing metal ions or coating particles.

The study cautions, "**the release of toxic inorganic constituents during their weathering under acidic or alkaline conditions in the human body** or the environment may cause unintended harm that might be difficult to predict with short-term toxicity tests."

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**Cell sensitivity to quantum dots (QDs) has been attributed to a cascade triggered by oxidative stress leading to apoptosis**. The role and function of mitochondria in animal cells are well understood but little information is available on the complex genetic networks that regulate nucleo-mitochondrial interaction. The effect of CdS QD exposure in yeast Saccharomyces cerevisiae was assessed under conditions of limited lethality ( < 10%), using cell physiological and morphological endpoints. Whole-genomic array analysis and the screening of a deletion mutant library were also carried out. **The results showed that QDs: increased the level of reactive oxygen species (ROS) and decreased the level of reduced vs oxidized glutathione (GSH/GSSG); reduced oxygen consumption and the abundance of respiratory cytochromes; disrupted mitochondrial membrane potentials and affected mitochondrial morphology**.

**in plant The ratio of reduced glutathione levels (GSH) relative to**
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**the oxidized glutathione (GSSG) in plants suggests that QDs caused oxidative stress on the plant at this condition [74]. In animal Yan et al. investigated the potential vascular endothelial toxicity of mercaptosuccinic acid (2-sulfanylbutanedioicacid)-capped QDs in vitro . Their results suggested that QDs could not only impair mitochondria but also exertendothelial toxicity through activation of mitochondria**

**Exposure affected the capacity of cells to grow on galactose, which requires nucleo-mitochondrial involvement. However, QDs exposure did not materially induce respiratory deficient (RD) mutants but only RD phenocopies. All of these cellular changes were correlated with several key nuclear genes, including TOM5 and FKS1, involved in the maintenance of mitochondrial organization and function. The consequences of these cellular effects are discussed in terms of dysregulation of cell function in response to these "pathological mitochondria--Tang et al. 63 described how CdTe QDs (19 μM) can induce mitochondrial dysfunction in Danio rerio (zebrafish) liver cells. Pasquali et al. 34 reported that in S. cerevisiae, exposure to 75−150 mg L −1 CdS QDs increased the levels of ROS and modified the redox state by decreasing the levels of reduced/total glutathione (GSH/GSSG+GSH); in addition, there was a reduction of both oxygen consumption and cytochrome c abundance, with a consequent disruption of membrane potential and modification of organelle morphology. Interestingly, some of these phenotypic changes are consistent with observations on selected tolerant knockout mutants identified by Marmiroli et al. 64 indicating the protective role of this organelle in the response to ENM exposure. ...**

Qdots  what you may see when removing biofilm --polymer or just having a release the QDots encased inside a protein