Practical Applications of Nanotechnology

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Data use is courtesy of Dr. Nicanor Moldovan
Does anyone actually use the techniques we’ve learned?
Fluorescence in science

- Widely used for either marking or quantifying things
  - In biology, one of the most well-known fluorescent markers is GFP (Green Fluorescent Protein)
  - GFP fluoresces under ultraviolet light
  - Gene isolated from a species of jellyfish (*Aequorea victoria*)
  - Can be spliced into cells or animals to track cells, or show the activity level (expression) of other genes
Examples of genetically engineered animals with GFP
How exactly is it used?

- Tracking cells
  - If a scientist implants cells from a donor organism into a recipient, they need to know if the donor cells survived
  - By using donor cells expressing GFP, we can differentiate the donor cells from the normal recipient cells because the donor cells will fluoresce, and the recipient cells will not
In biology, we say that a gene is being “expressed” when it is actively being synthesized into protein or another product.

- (Generally) The more active a gene is, the more product is being made
- Conversely, when a product is being made, its gene is active (i.e. it is expressed!)
How exactly is it used? (cont.)

- We can use this fact to confirm successful gene transfer using a “reporter gene” (one that turns the cell fluorescent when the transfer works)

![Diagram of gene expression and reporter gene](http://en.wikipedia.org/wiki/File:Reporter_gene.png)

- i.e. what turns the gene “on”
- Another fluorescent gene
- The process of making a protein from a gene
- If the cell glows, it means that the GFP product is being made, and the gene is active and expressed!
Also, commercially available pets!
— GloFish®

Real life example

- I use both fluorescence and calibration curves in my research.
- For my research, I attach tiny magnetic (iron) beads to cells—this lets me move the cells wherever I want using a magnet.
  - I link the bead to an antibody that will only attach to a specific type of cell.
  - The cell has a slot for that particular type of antibody.
Application

- Briefly, petri dishes are not a very realistic surface on which to grow cells
- 2-D dish versus 3-D body
- So we put cells on a synthetic 3-D structure
  - But must get cells to penetrate structure, otherwise they just sit on top
  - This is what we use the magnet for!
- But, we also need to know how many cells actually penetrated

http://bioengreu.slu.edu/projects09/paranjape/images/1505Ipaper.jpg
Calibration curve

- I make a series of dilutions of cells (of a known concentration) and lyse (break) them to release the DNA

- The cells are broken using detergents (remember the micelle question in the lab memo?)

- The DNA is then combined with a chemical that fluoresces on contact.
  - More DNA → More fluorescence
Calibration Curve Example

Fluorescence

Concentration of cells
Results

Number of cells that penetrated the structure

Conditions: Beads attached to the cells with antibodies, plain beads (control), plain cells (control)