

# Genetically Modified Organisms: Part I. Making a transgenic organism

US275 Scientific Ethics  
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## Transgenic organisms have an insertion or deletion of specific genes

- insertion or deletion of DNA
  - desired gene
  - from another organism
  - now possible to synthesize unique genes



*Glowing Tobacco plant expressing the  
firefly luciferase gene.*  
Wikimedia Commons, Science 1986

## Bacteria were the first genetically modified organisms.

- specific purposes
  - human insulin
  - clotting factor VIII
- controlled environments



<http://gmpbio.org/clinical-production/GMP-protein-production>

# NIH established the Recombinant DNA Advisory Committee in 1974

- Oversight of recombinant DNA research
- NIH Guidelines for research Involving Recombinant DNA Molecules
  - 1976 + many revisions
- appropriate biosafety practices and containment measures



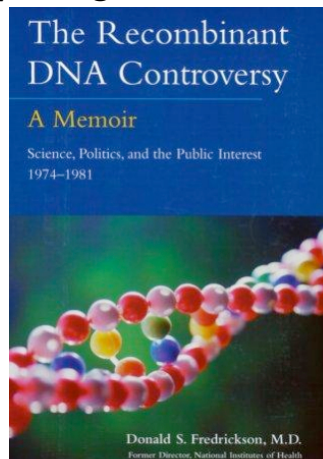
# The original rules for recombinant DNA research were issued in 1976

- physical containment
  - controlled spaces
  - minimize risk of “escape”
- biological containment
  - modified organisms so that they could not survive outside of the laboratory



# The RAC continues to review and provide guidelines on potentially dangerous work.

- Drug-resistant microorganisms
- genes for highly toxic proteins
- disease causing organisms for which there is no current cure
- Human Gene transfer studies



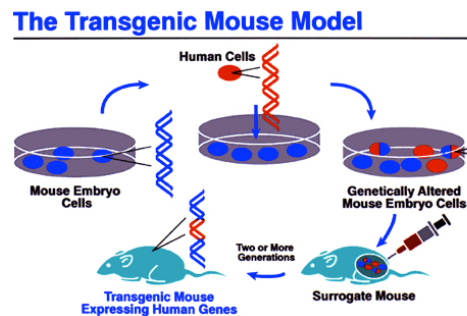
## The Recombinant DNA Advisory Committee remains active in making important recommendations and policy decisions

- provides guidelines on
  - basic and clinical research involving recombinant DNA
  - reviews human gene transfer research



## Transgenic organisms receive genes from other organisms.

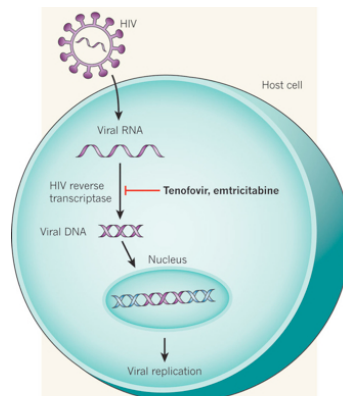
- use vectors to deliver genes to the target cells
  - viruses
  - nuclear injection
  - Gene gun



[http://www.wpclipart.com/medical/testing/Transgenic\\_Mouse.png.html](http://www.wpclipart.com/medical/testing/Transgenic_Mouse.png.html)

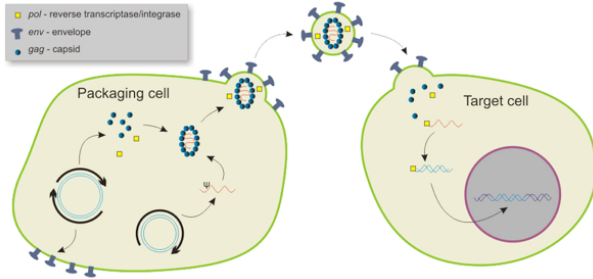
## Viral vectors insert DNA directly into the genome of infected cells.

- normal virus
  - virus infects cell
  - viral DNA takes over cell
  - cell makes more viruses



Wainberg (2011) AIDS: Drugs that prevent HIV infection. *Nature* **469**, 306–307

# Viral vectors are modified so they can't replicate on their own.



- viral particles are created in a packaging cell
  - does not include the genetic information to make new "infectious" virus particles
- infected cell receives and uses the new DNA

Wikimedia Commons

# The gene gun was developed to deliver DNA to plant cells

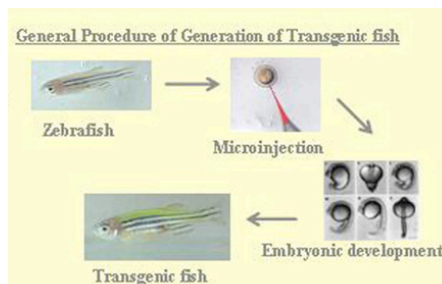
- now can be used to deliver DNA-coated gold pellets into difficult cells
  - cells in intact organisms (ex. skin cells)
- Used to deliver DNA vaccines



<http://www.wired.com/wired/archive/10.09/gvaccines.html>

# Nuclear injection of DNA into the nucleus of an egg is used to create new breeds of animals

- new gene in all cells of organism
- can be passed to offspring and all future generations



Development of Transgenic Zebrafish  
[http://www.glofish.com/Development\\_of\\_Transgenic\\_Fish.jpg](http://www.glofish.com/Development_of_Transgenic_Fish.jpg)

# Glofish were modified to express fluorescent proteins

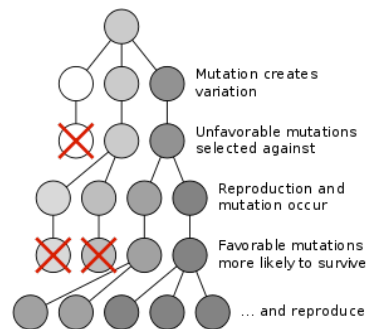
- Zebrafish (zebra danio, *Danio rerio*)
- Designed for scientific experiments to indicate polluted water
- FDA ruled not a food source
  - no greater risk to environment than normal zebra fish
  - illegal in California, Canada, European Union, Australia



Glofish(R) Fluorescent fish  
[www.glofish.com](http://www.glofish.com)

A major risk of any genetic modification is that the new DNA will disrupt the function of an important gene.

- fixing one problem
  - will cause a new one
- insertion into an existing gene
  - often lethal
  - but may have minor effects



Wikimedia Commons

## TO BE CONTINUED

In Genetically Modified Organisms  
Part II: Examples and Concerns

# Any Questions?

Email me at:  
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<http://www.vipitbullkennels.com/images/animated-question-mark.gif>