

DNA technology:

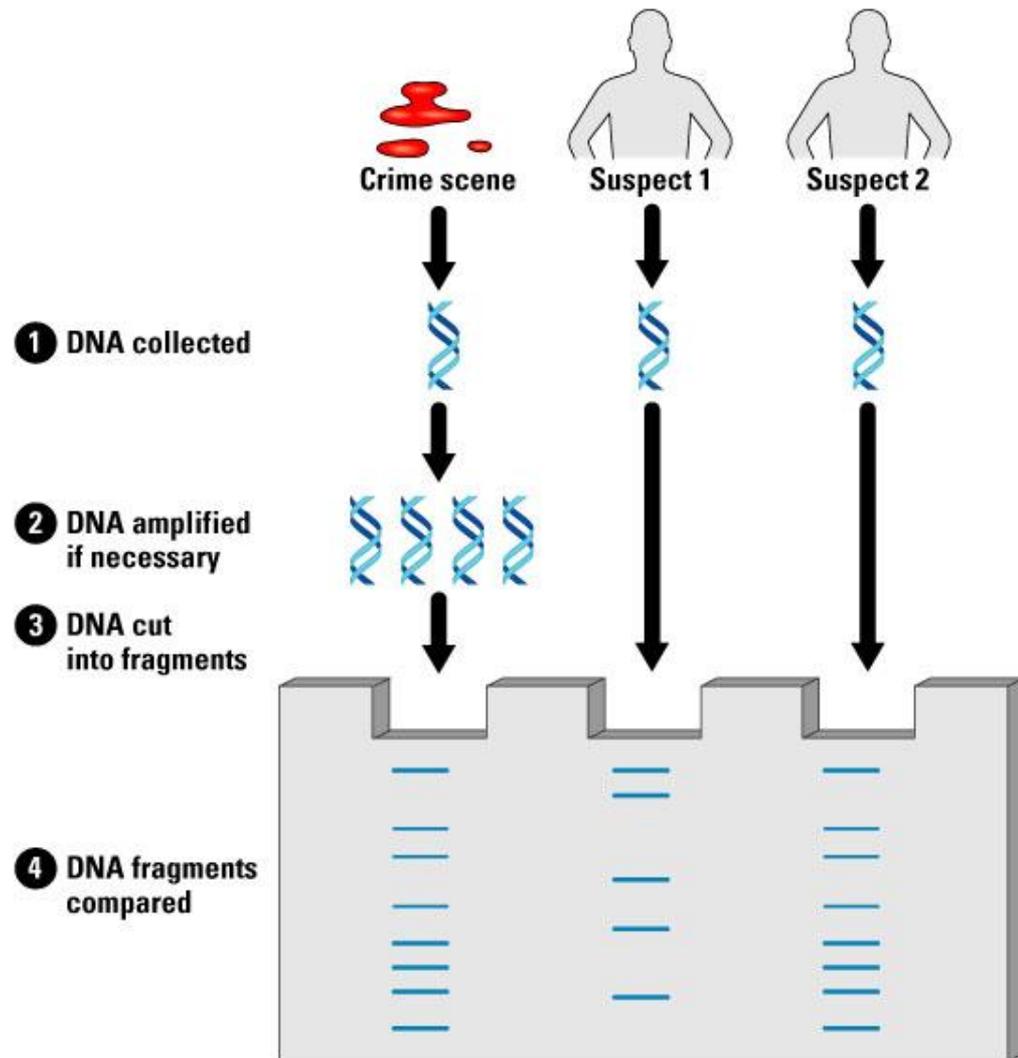
Manipulating DNA to create technologies used in crime investigators, agriculture and medicine

DNA fingerprinting aka DNA profiling

DNA is amplified via a method
Called PCR

DNA is cut into fragments
With an enzyme called
Restriction enzymes

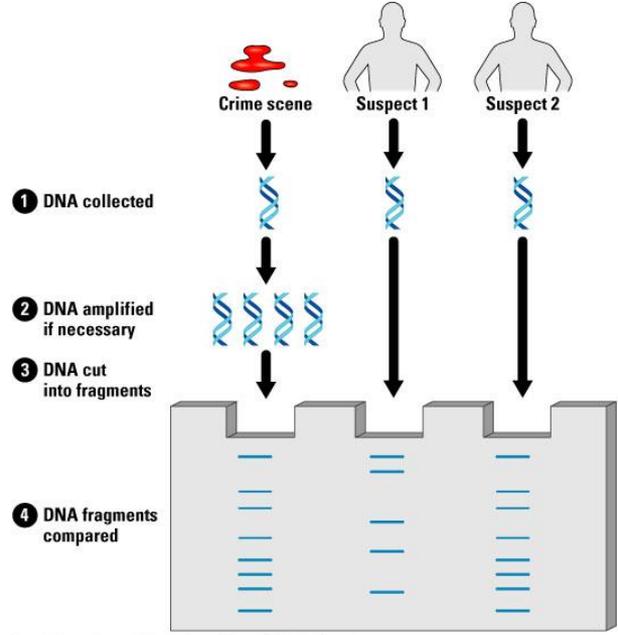
DNA fragments are separated
By size



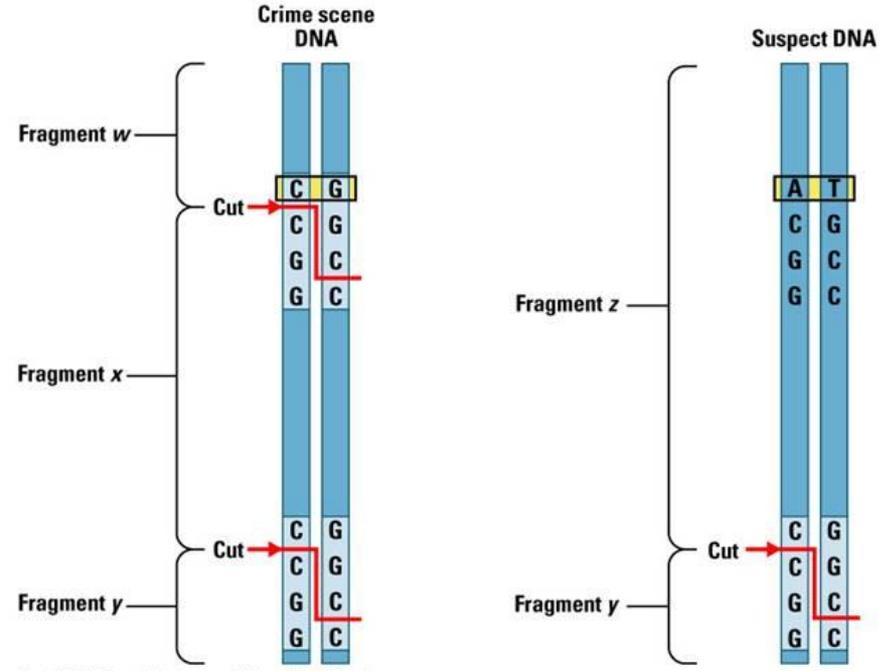
DNA fingerprinting aka DNA profiling

produces a unique pattern of bands
that tells people apart
(a band is group of DNA fragments
of similar size)

USES:
Crimes and paternity cases



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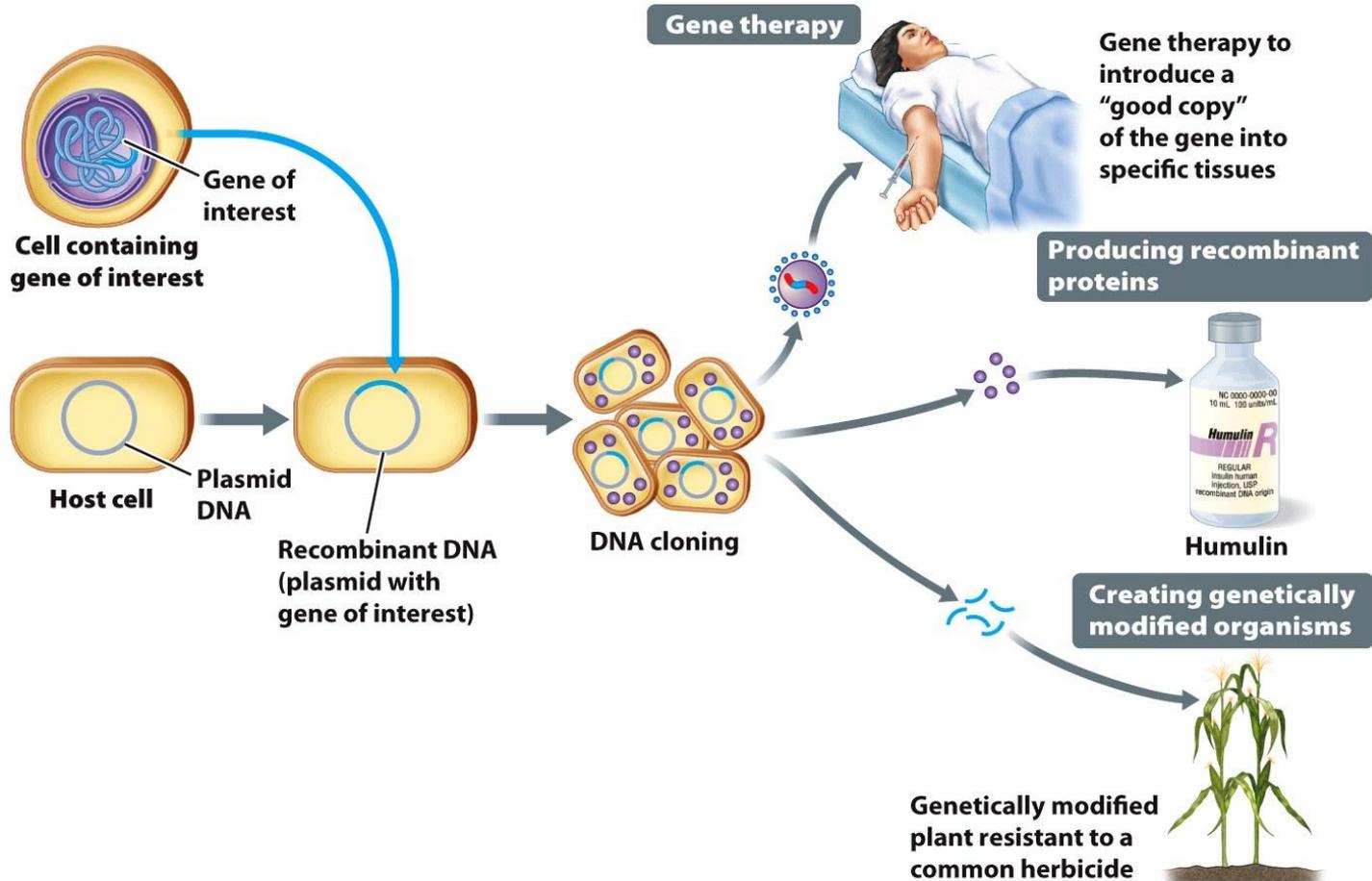
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Genetic Engineering

is moving genes from one organism to another using rDNA

Applications:

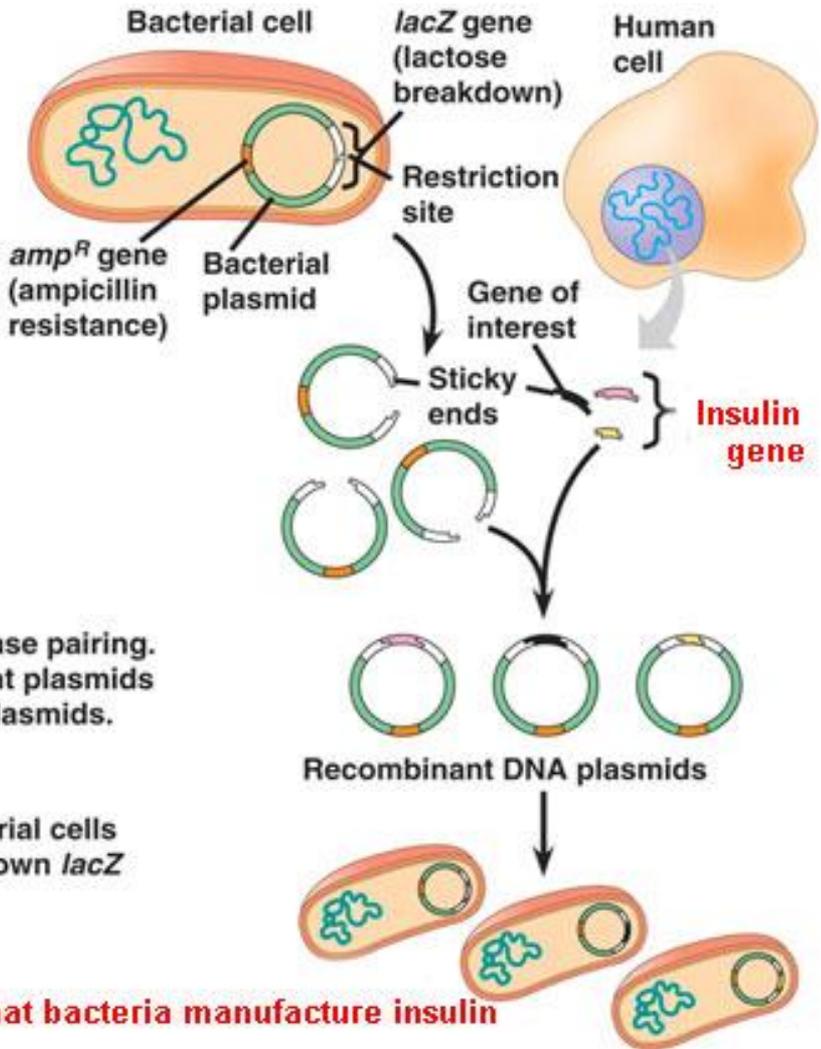
SOME APPLICATIONS OF DNA CLONING



Genetically Modified Organisms: recombinant bacteria

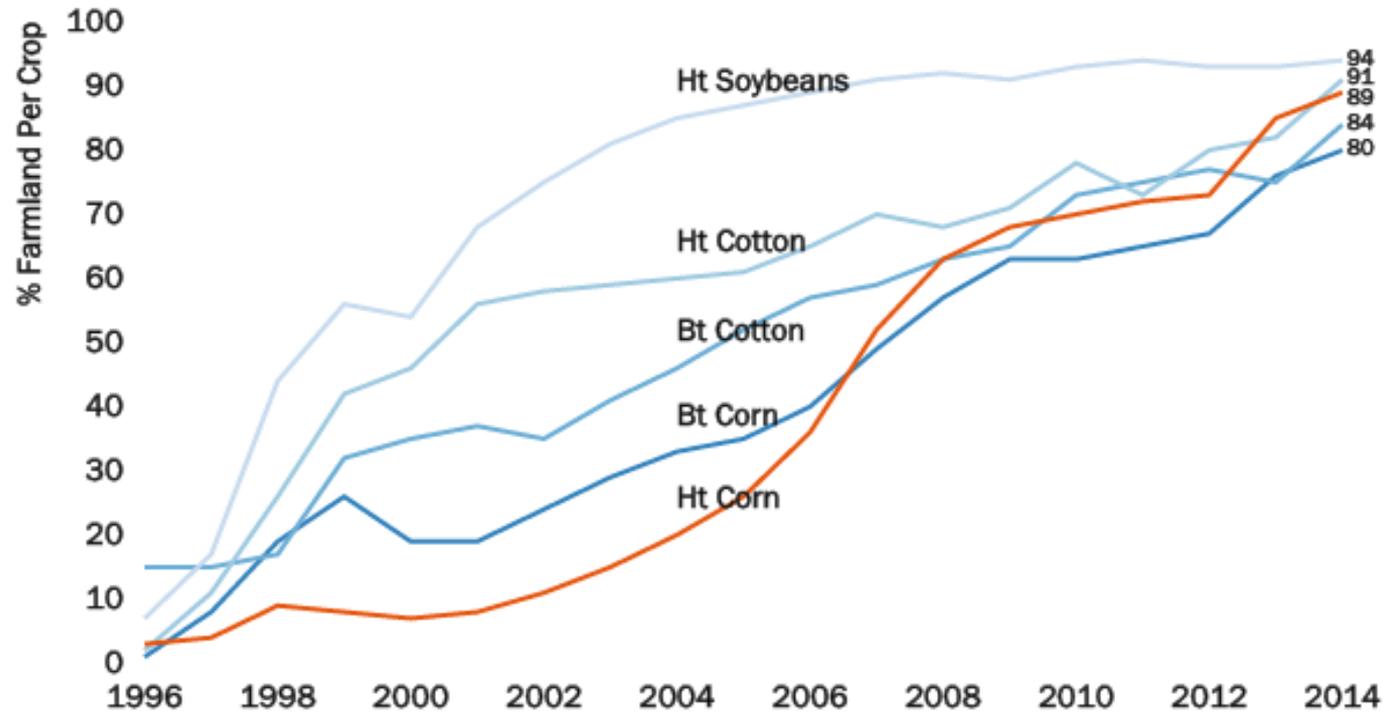
Examples:
Insulin
Hepatitis B vaccine
Human growth hormone

- 1 Isolate plasmid DNA and human DNA.
- 2 Cut both DNA samples with the same restriction enzyme.
- 3 Mix the DNAs; they join by base pairing. The products are recombinant plasmids and many nonrecombinant plasmids.
- 4 Introduce the DNA into bacterial cells that have a mutation in their own *lacZ* gene.



GMO crops production

Adoption of GMO Crops in the US, 1996-2014

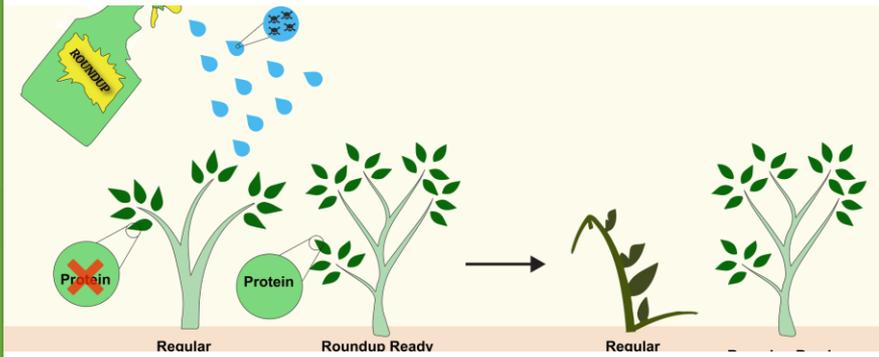
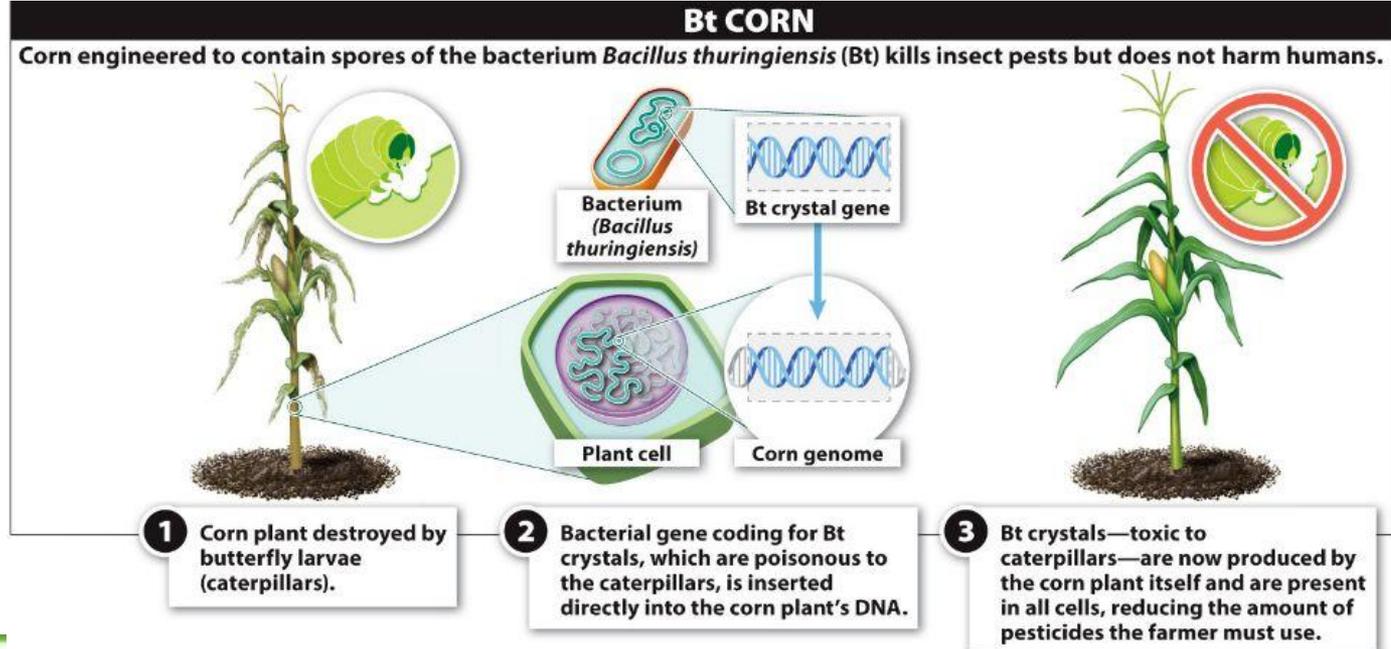


Ht: Herbicide-tolerant **Bt:** Insect-resistant

Source: [USDA Economic Research Service](#)

Genetically Modified Organisms: crops

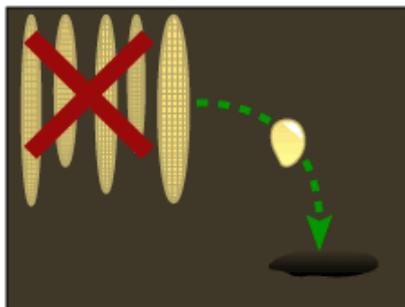
Bt crops:



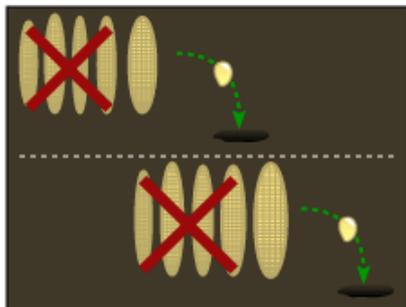
How is genetic engineering of crops or animals different than traditional selective breeding?



1. Natural variation occurs in the wild population.



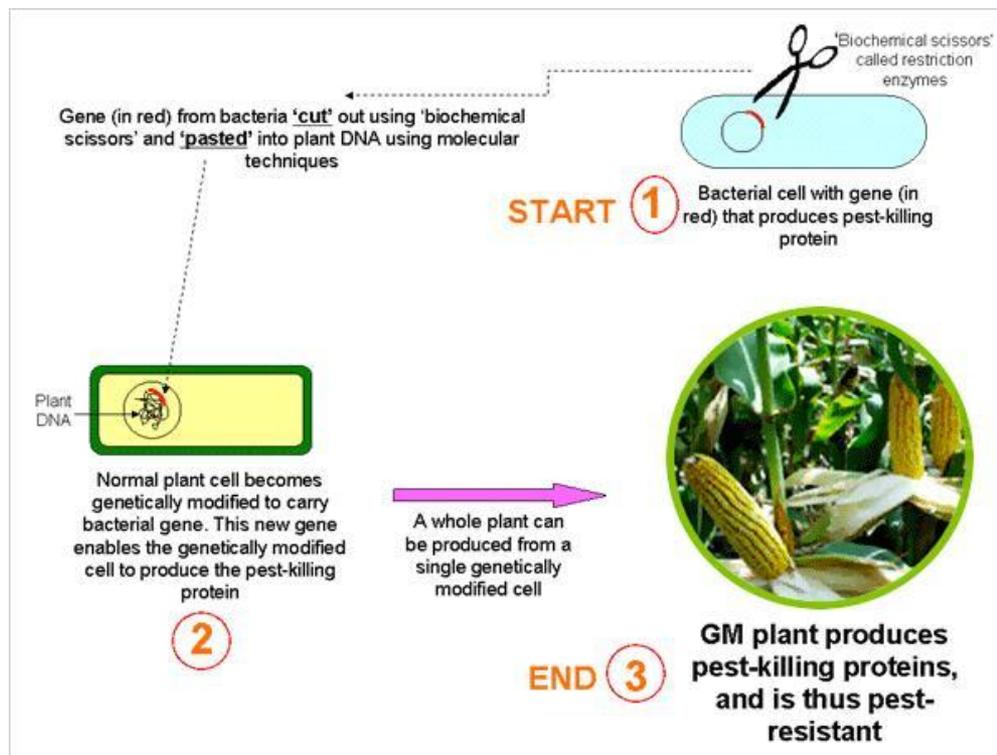
2. Seeds for the next generation are chosen only from individuals with the most desirable traits.



3. Repeat this process for several generations.

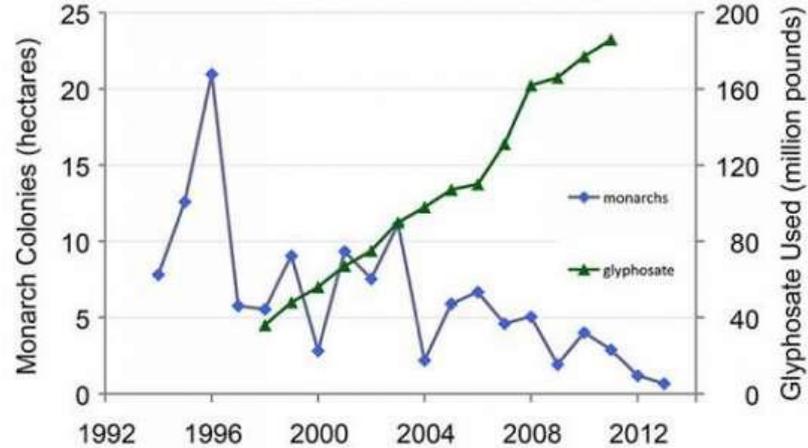


4. Over time, the quality of the crop increases.

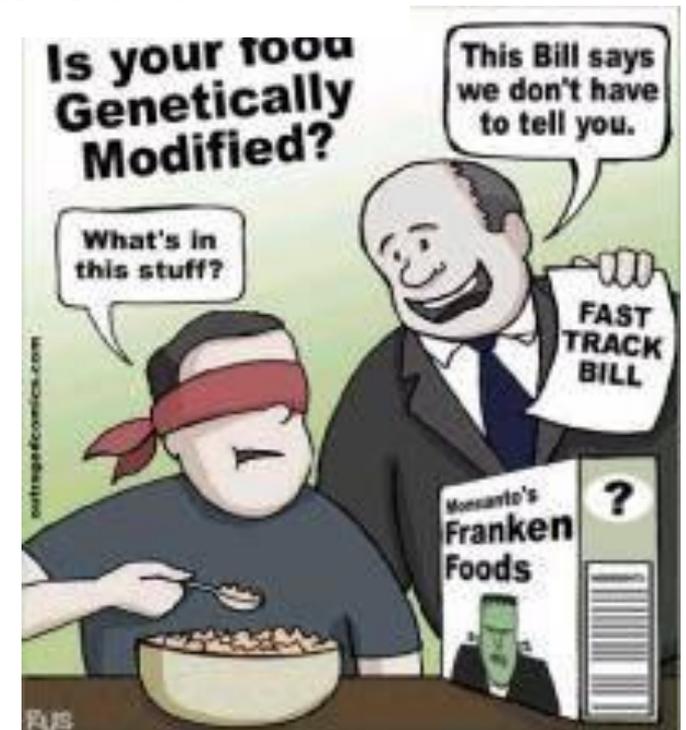


Concerns of the use of GM crops

- *Environmental*
monarchs



- **Social**
Should food made with GMOs be labeled?



Pharm crops

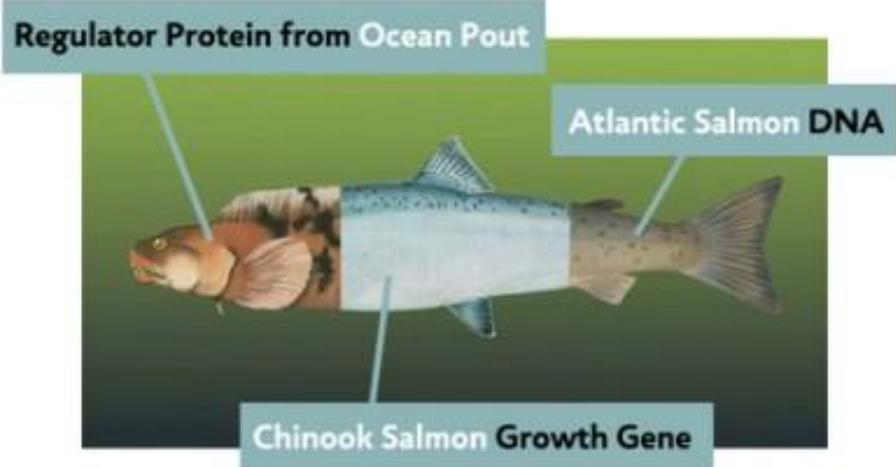
Most pharm crops are in pre-commercial field trials, but at least two proteins used in biochemical and diagnostic procedures are already being grown in corn for commercial use – avidin and beta-glucuronidase. Other proteins from pharm crops are already in clinical trials.

Commercial Pharma/Industrial Crop Products

Product	Trade Name	Pharma Crop	Source of Genes	Commercial Purpose ¹
Aprotinin	AproliZean	Corn	Cow	Research and manufacturing
Aprotinin	Apronexin	Tobacco ³	Cow	Research and manufacturing
Avidin	Recombinant avidin	Corn	Chicken	Research and diagnostic reagent
B-glucuronidase (GUS)	Not available	Corn	Bacteria	Research and diagnostic reagent
Trypsin	TrypZean	Corn	Cow	Research and manufacturing
Lactoferrin	Not available	Rice	Human	Research
Lysozyme	Not available	Rice	Human	Research



Genetically Modified Organisms: fish

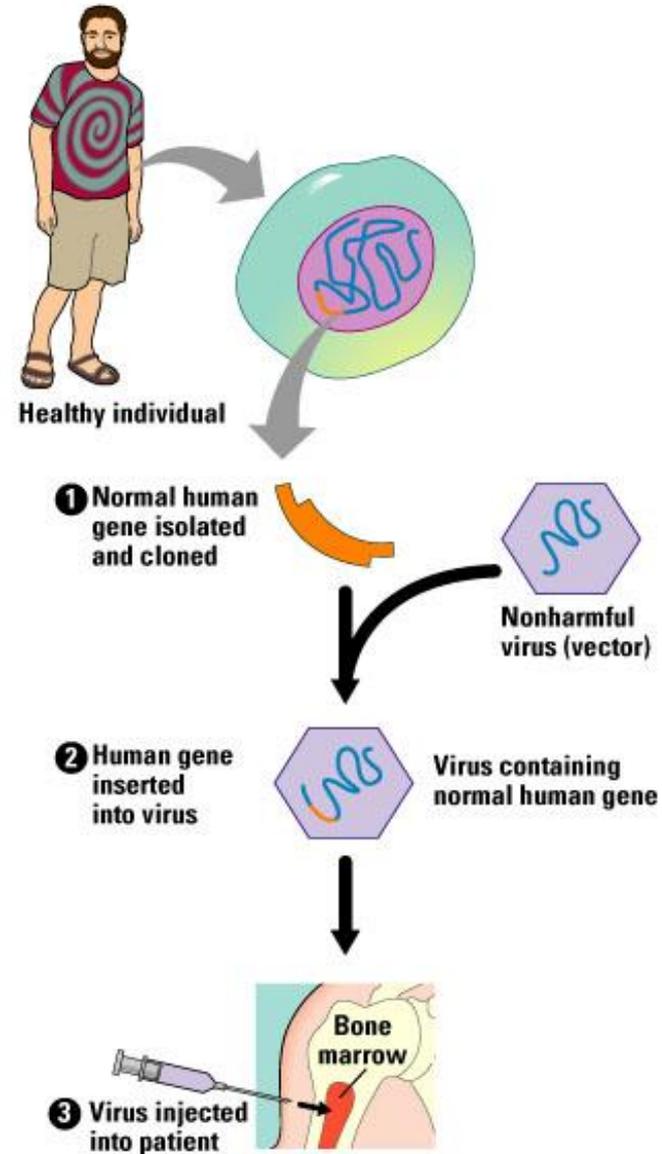


Gene Therapy uses recombinant DNA

A patient is provided with
a new gene via a non harmful virus

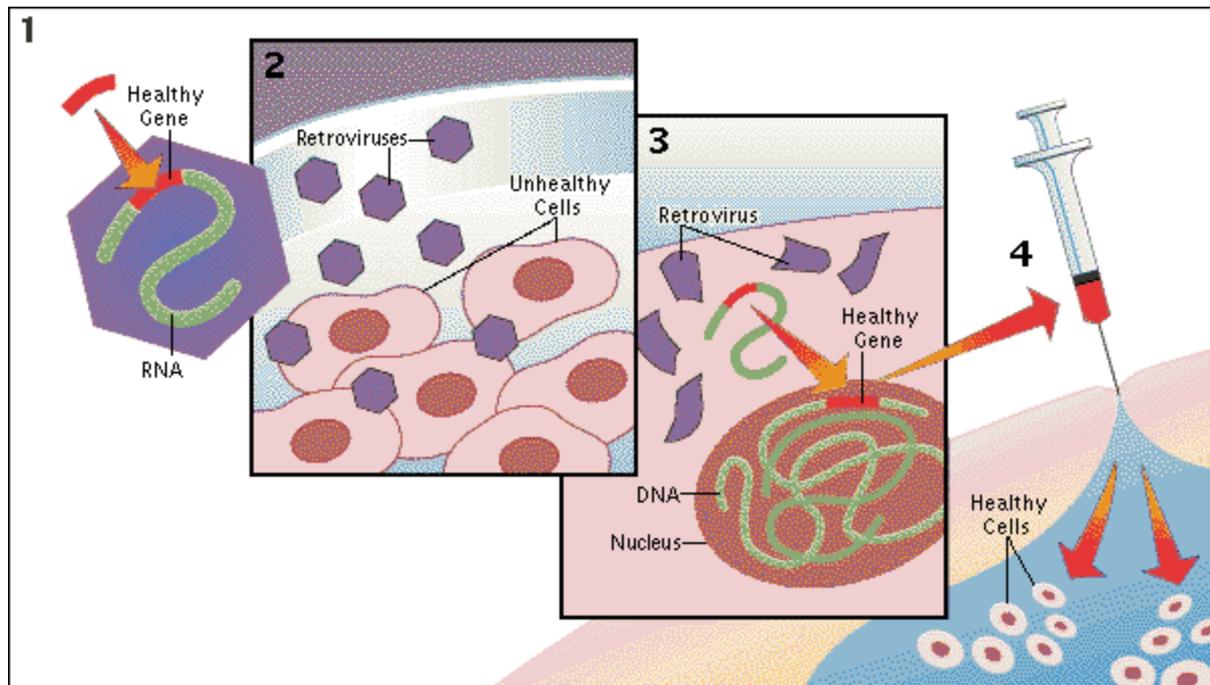
*What is the difference between
GM plant and a patient treated with Gene therapy?*

USE:
To cure persons with a genetic disease



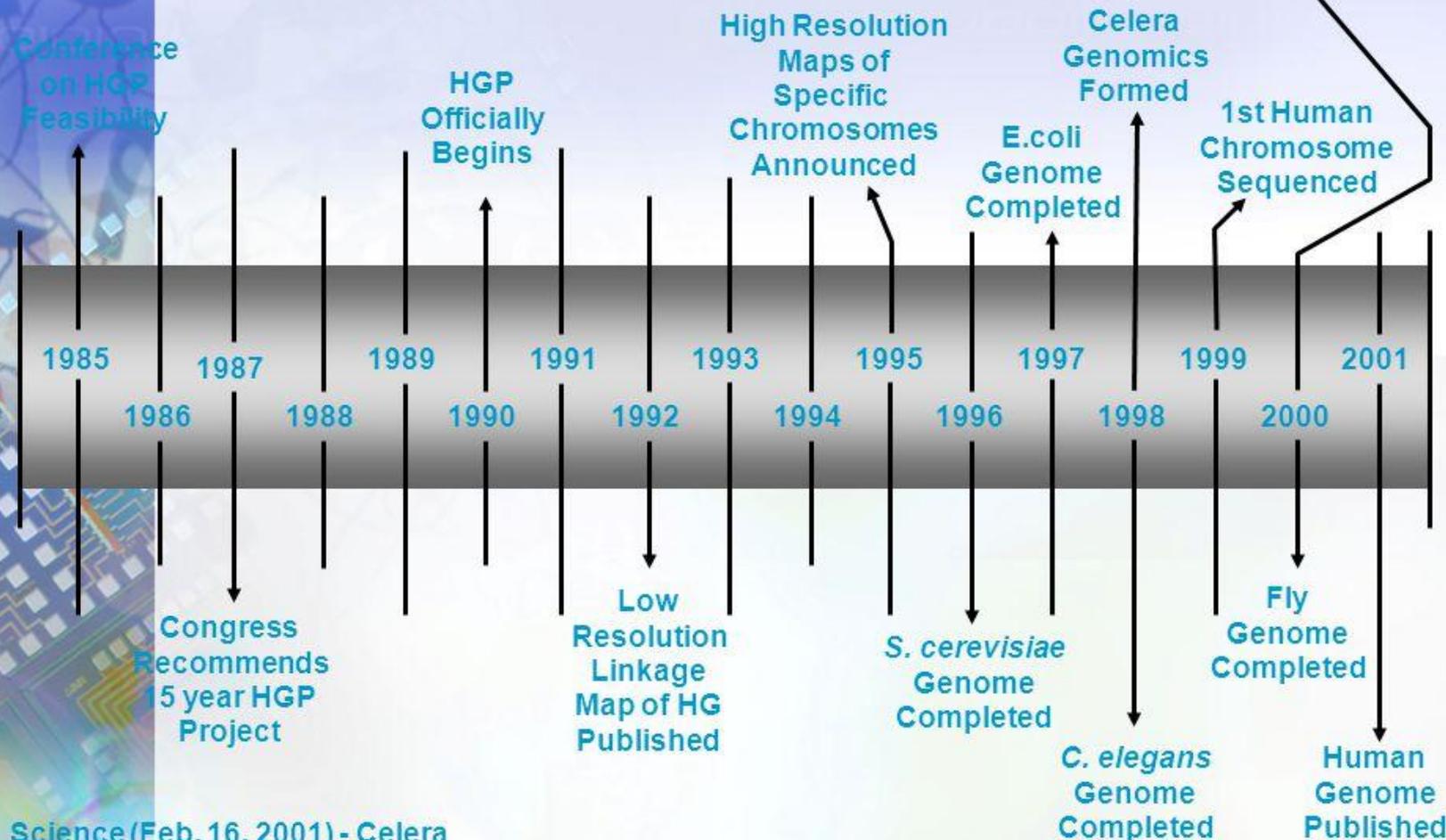
Concerns of Gene Therapy

- Will the vector (virus) cause any harmful effects on the person?
- Will the rDNA be introduced in another functioning gene?
- Should Gene therapy be used to enhance the ability of a person?



Genomics: the study of Genomes

The Human Genome Project - Timelines -



Science (Feb. 16, 2001) - Celera
Nature (Feb. 15, 2001) - HGP

Genomics: the study of Genomes

Human Genome
has 3 billion nucleotides

Only 20,000 genes
→ 1.5% of the genome

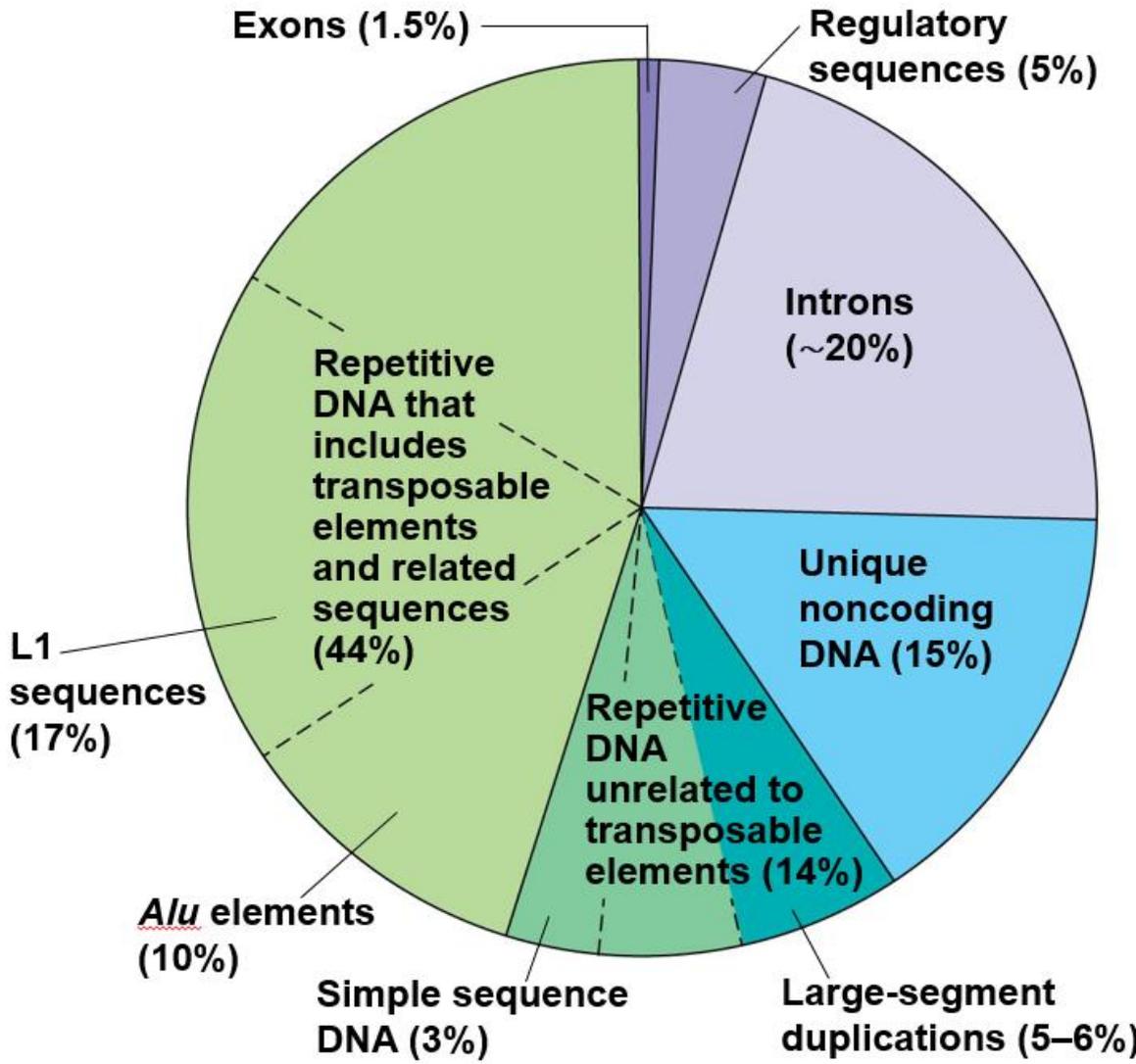
5% regulatory sequences

20% introns

Most of our DNA
Is repetitive DNA

It was referred as
Junk DNA

However it is highly
Conserved across species
Suggesting that it must
Have important functions



Patenting and genetic testing

A look back at the historical ruling on **human gene patents**

Source: American Liberties Civil Union and the Supreme Court

May 12, 2009

Association for Molecular Pathology (AMP) filed a lawsuit against Myriad Genetics and the University of Utah Research Foundation, which hold patents on the genes BRCA1 and BRCA2.

March 29, 2010

New York federal court ruled that BRCA1 and BRCA2 gene patents were invalid.

July 29, 2011

The Court of Appeals for the Federal Circuit ruled that companies can acquire patents on genes and reinstated Myriad Genetic's patent.

March 26, 2012

The Supreme Court vacated the federal appeals court's decision and instructed that they reconsider the issue in light of the case *Mayo Collaborative Services v. Prometheus Laboratories, Inc.*

Nov. 30, 2012

The Supreme Court agreed to hear the argument on human gene patenting.

April 15, 2013

The plaintiffs argued the case against human gene patents before the Supreme Court.

June 13, 2013

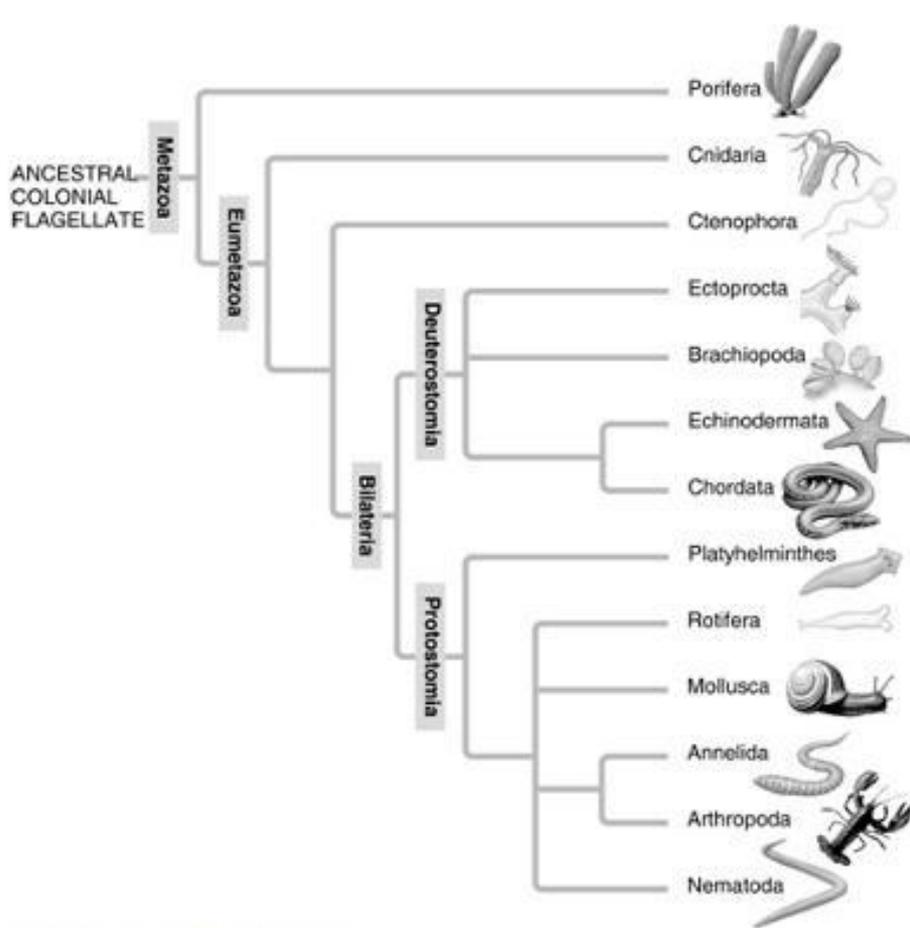
The Supreme Court unanimously ruled that human genes cannot be patented.

August 16, 2012

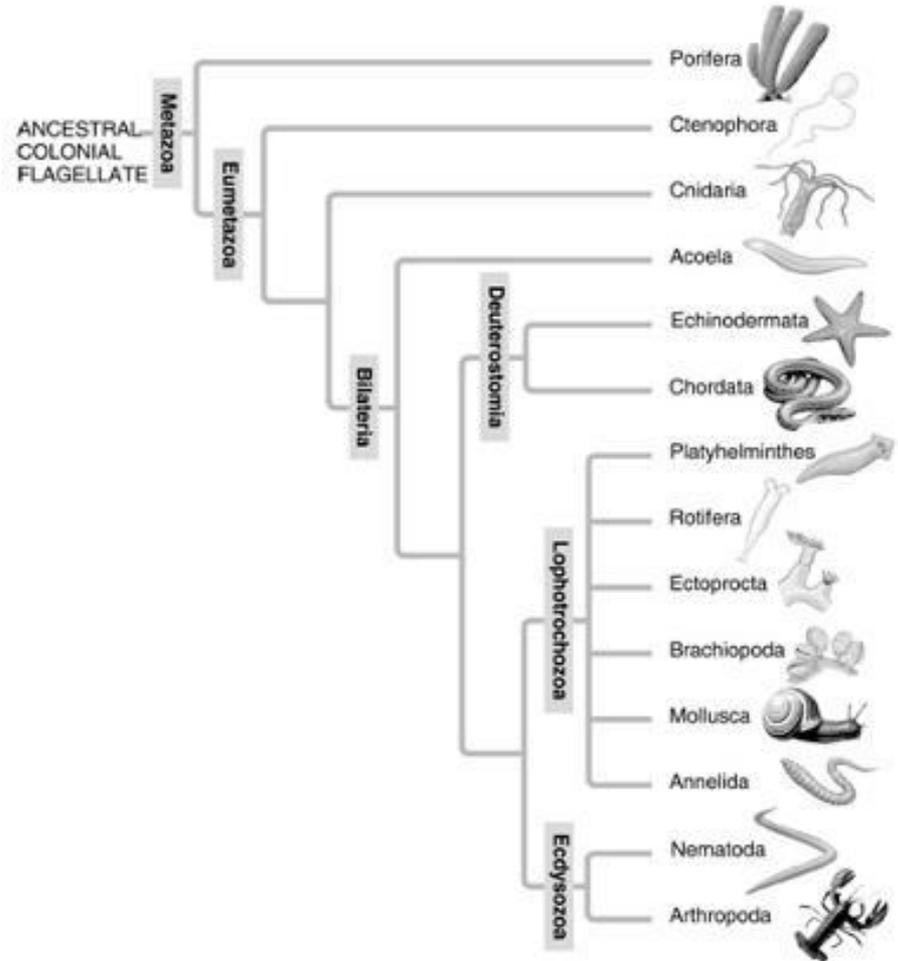
Federal appeals court once again ruled that genes are patentable, but invalidated patents on methods to compare the genes.

Lauren Smith *The Daily*

Comparing genome sequences provides clues into evolution



A: Morphological phylogeny.



B: Molecular phylogeny.

Exercise 8

- Procedure 2 and 3.
Answer questions