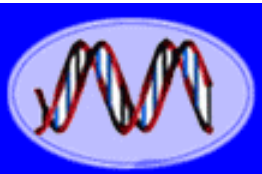
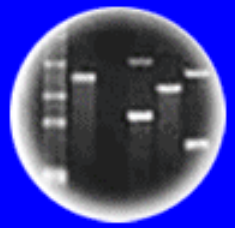


DNA
Genetic Code of Life

Entire Genetic Code
of a Bacteria



DNA Fingerprinting

Cloning: Ethical Issues
and Future Consequences

Plants of Tomorrow

HC70A & SAS70A Winter 2011
Genetic Engineering in Medicine, Agriculture, and Law

Professors Bob Goldberg & John Harada

Lecture 1
The Age of DNA; What Is Genetic Engineering?

UCLA

Turn Off Your Cell Phones!!

UCDAVIS
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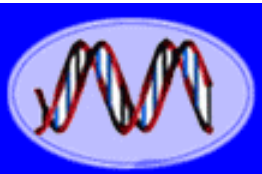

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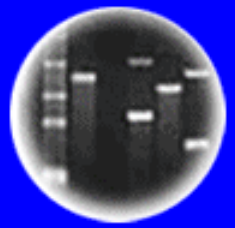

DNA Fingerprinting

Cloning: Ethical Issues
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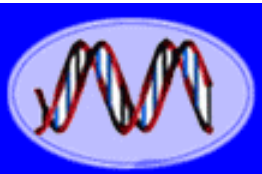
Plants of Tomorrow

THEMES

1. The Age of DNA, Genomics, Genetic Engineering & Synthetic Organisms
2. What Do Genes Look Like - DNA Demonstration
3. DNA Into Your Home
4. How Was Modern Genetic Engineering "Invented?"
5. What Is Genetic Engineering & How Has It Affected Our Lives?
6. What Can Be Done With Genetic Engineering?
7. What Does Genetic Engineering Tell Us About Genetic Processes?
8. What Is the Scientific Method?
9. Genetic Engineering - Anything New?
10. Classical vs. 21st Century Genetic Engineering - Demonstration
11. Era of Genomics,Genetic Engineering, & Synthetic Life - Impact on Humankind?



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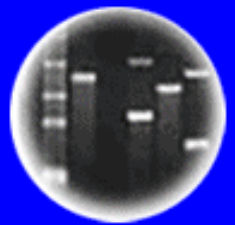

DNA Fingerprinting

Cloning: Ethical Issues
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Plants of Tomorrow

Going Long Distance
HC70A & SAS70A Winter 2011

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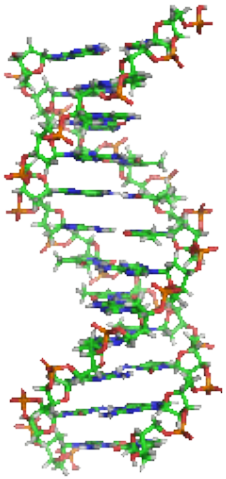
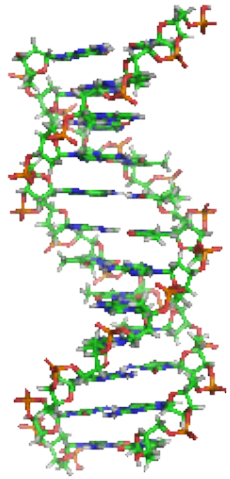
UCLA

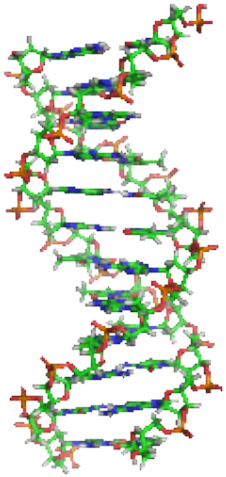
A Model For Cross-Campus Interactive Learning

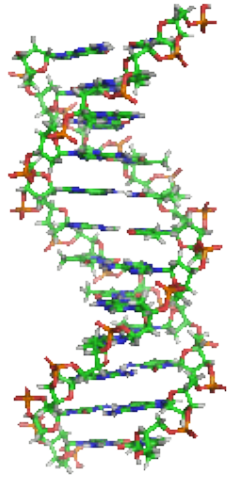




We Live in
The Age of DNA!

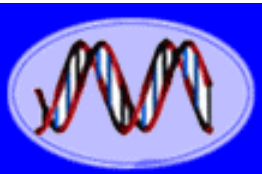
Genetic Engineering Is Manipulating DNA!





DNA is Part of Our Culture!!

"It's Part of Their/Our DNA!"



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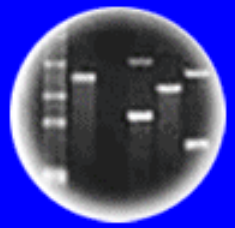

DNA Fingerprinting

Cloning: Ethical Issues
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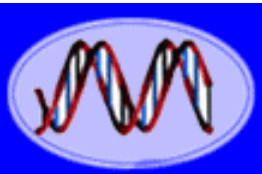
Plants of Tomorrow

We Live in the Era of....

- Genes & DNA
- Genomics & Genome Sequencing
- Genetic Engineering of Microbes, Plants, & Animals
- Biotechnology Using Genetic Engineering Technology
- Synthetic Microbes Made by "Man"
- Personalized Genomes and Ability to Identify Any Individual Using DNA
- Mammalian Reproduction, Stem Cells & Cloning

And the SYNTHESIS of These Technologies!!



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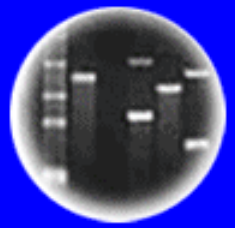

DNA Fingerprinting

Cloning: Ethical Issues
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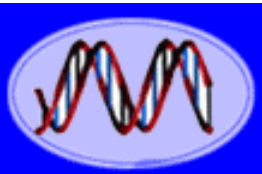
Plants of Tomorrow

Genetic Engineering……..

- Is the Most Revolutionary Technology in Biology to Have Been Invented to Date!

- Has Generated the Vast Majority of New Biological Knowledge Over the Past 37 Years From Experiments in Biology Laboratories Around the Globe

- Has Changed Our Lives Dramatically!



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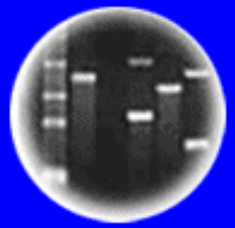
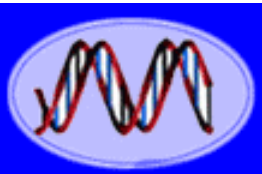


DNA Fingerprinting

Cloning: Ethical Issues
and Future Consequences

Plants of Tomorrow

- From New Medicines
- To Better Crops
- To the Sequence of the Human Genome & Ancient Genomes
- To Novel Ways To Identify Individuals
- To Understanding the Basis of Human Disease and Aging
- To Personalized Genomes and Medicine
- To Creating Synthetic Organisms
- To the Ability to Eventually Unravel the Mysteries of ALL Cellular Processes!
- To Ultimately -- Immortality?



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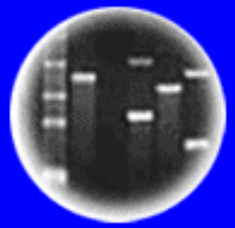

DNA Fingerprinting

Cloning: Ethical Issues
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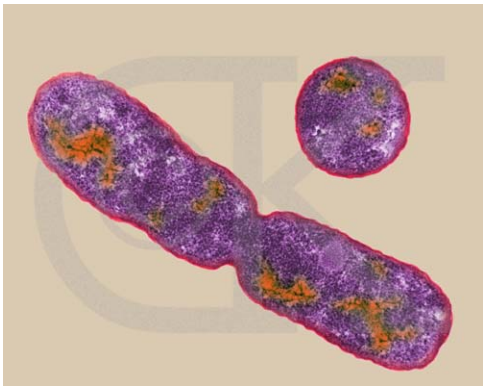
Plants of Tomorrow

Genetic Engineering Can Now Be Used To Synthesize Entire Chromosomes From Chemicals and Create Synthetic Microbes in a Test Tube



2 JULY 2010 VOL 329 SCIENCE www.sciencemag.org

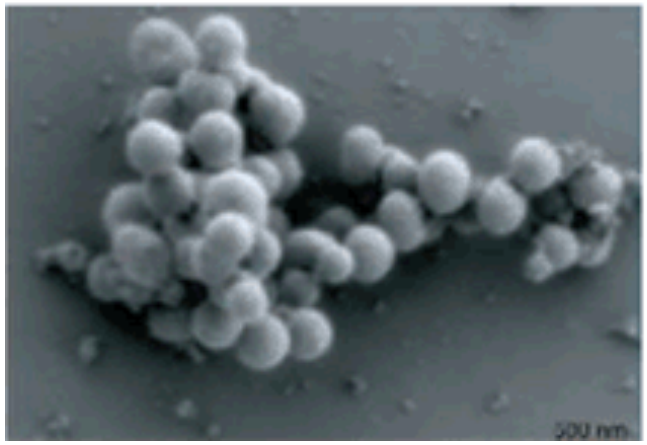
Creation of a Bacterial Cell Controlled by a Chemically Synthesized Genome

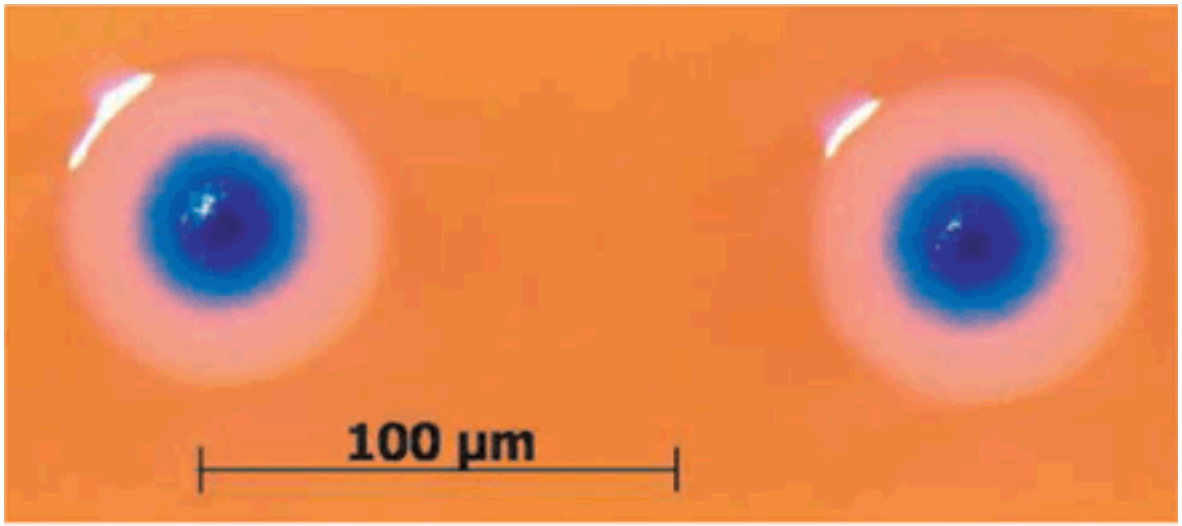
May 20, 2010

Researchers Say They Created a 'Synthetic Cell'

By NICHOLAS WADE

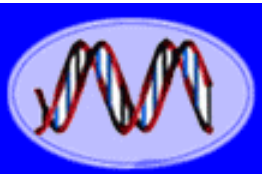
The genome pioneer J. Craig Venter has taken another step in his quest to create synthetic life, by synthesizing an





Creating Life: Synthetic Microbes
J. Craig Venter

60 Minutes-December 2010



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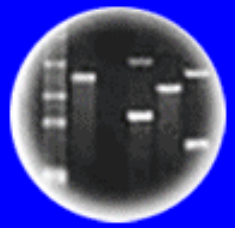

DNA Fingerprinting

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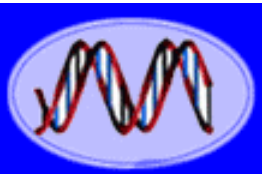
Plants of Tomorrow

Question One

Are You Uncomfortable With Creating Microbes With Synthetic Genomes?

a. Yes

b. No



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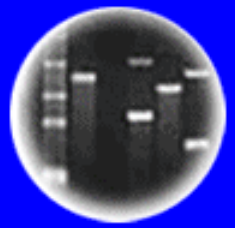

DNA Fingerprinting

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Plants of Tomorrow

DNA Can Be Used To Look Into The Past and "Bring Back the Dead!!

RESEARCH ARTICLE

Science, May 7, 2010 (328, 710-722)

A Draft Sequence of the Neandertal Genome

From a 45,000 Year-Old Bone

Reconstruction by Kennis & Kennis / Photograph by Joe McNally

For the first time, a Neanderthal female peers from the past in a reconstruction informed by both fossil anatomy and ancient DNA. At least some of her kind carried a gene for red hair and pale skin.

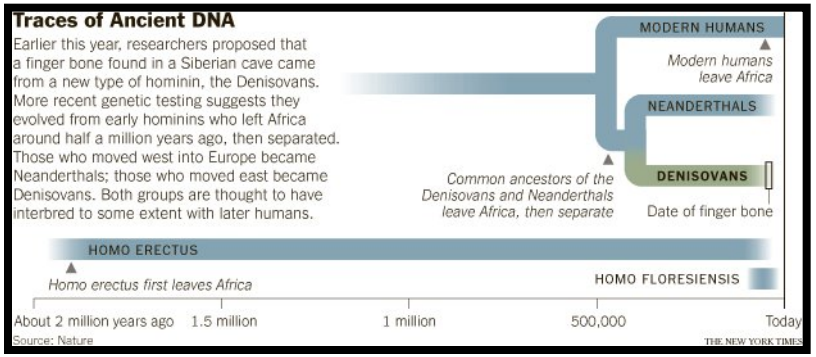
Nature, December 30, 2010 (468,1053-1060)

Genetic history of an archaic hominin group from Denisova Cave in Siberia

David Reich[1,2]*, Richard E. Green[3,4]*, Martin Kircher[3]*, Johannes Krause[3,5]*, Nick Patterson[2]*, Eric Y. Durand[6]*, Bence Viola[3,7]*, Adrian W. Briggs[1,3], Udo Stenzel[3], Philip L. F. Johnson[8], Tomislav Maricic[3], Jeffrey M. Good[9], Tomas Marques-Bonet[10,11], Can Alkan[10], Qiaomei Fu[3,12], Swapan Mallick[1,2], Heng Li[2], Matthias Meyer[3], Evan E. Eichler[10], Mark Stoneking[3], Michael Richards[7,13], Sahra Talamo[7], Michael V. Shunkov[14], Anatoli P. Derevianko[14], Jean-Jacques Hublin[7], Janet Kelso[3], Montgomery Slatkin[6] & Svante Pääbo[3]

Using DNA extracted from a finger bone found in Denisova Cave in southern Siberia, we have sequenced the genome of an archaic hominin to about 1.9-fold coverage. This individual is from a group that shares a common origin with Neanderthals. This population was not involved in the putative gene flow from Neanderthals into Eurasians; however, the data suggest that it contributed 4–6% of its genetic material to the genomes of present-day Melanesians. We designate this hominin population 'Denisovans' and suggest that it may have been widespread in Asia during the Late Pleistocene epoch. A tooth found in Denisova Cave carries a mitochondrial genome highly similar to that of the finger bone. This tooth shares no derived morphological features with Neanderthals or modern humans, further indicating that Denisovans have an evolutionary history distinct from Neanderthals and modern humans.

DNA Sequence From 40,000 Year Old Fossil DNA!!



Vol 456|20 November 2008|doi:10.1038/nature07446 nature

Nature, November 2008

LETTERS

Sequencing the nuclear genome of the extinct woolly mammoth

Think About Bringing a Woolly Mammoth Back to Life!!

Webb Miller[1], Daniela I. Drautz[1], Aakrosh Ratan[1], Barbara Pusey[1], Ji Qi[1], Arthur M. Lesk[1], Lynn P. Tomsho[1], Michael D. Packard[1], Fangqing Zhao[1], Andrei Sher[2]‡, Alexei Tikhonov[3], Brian Raney[4], Nick Patterson[5], Kerstin Lindblad-Toh[5], Eric S. Lander[5], James R. Knight[6], Gerard P. Irzyk[6], Karin M. Fredrikson[7], Timothy T. Harkins[7], Sharon Sheridan[7], Tom Pringle[8] & Stephan C. Schuster[1]

PNAS

November 11, 2008

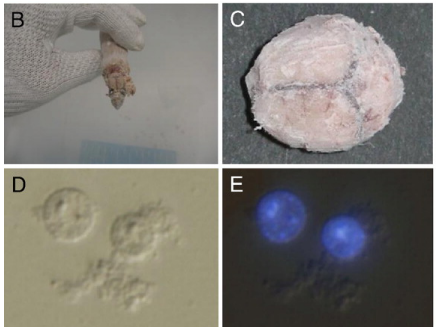
Production of healthy cloned mice from bodies frozen at −20°C for 16 years

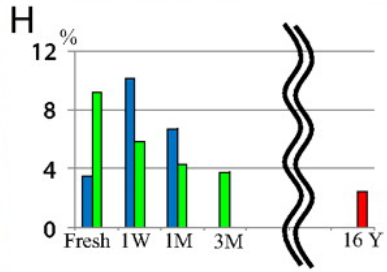
Think of the possibilities!

Sayaka Wakayama[a], Hiroshi Ohta[a], Takafusa Hikichi[a], Eiji Mizutani[a], Takamasa Iwaki[b], Osami Kanagawa[c], and Teruhiko Wakayama[a,1]

[a]RIKEN, Center for Developmental Biology, 2-2-3 Minatojima-minamimachi, Kobe, 650-0047, Japan; [b]Jikei University School of medicine, Tokyo 105-8461, Japan; and [c]RIKEN, Research Center for Allergy and Immunology, 1-7-22, Suehiro-cho, Tsurumi-ku, Yokohama, 230-0045, Japan

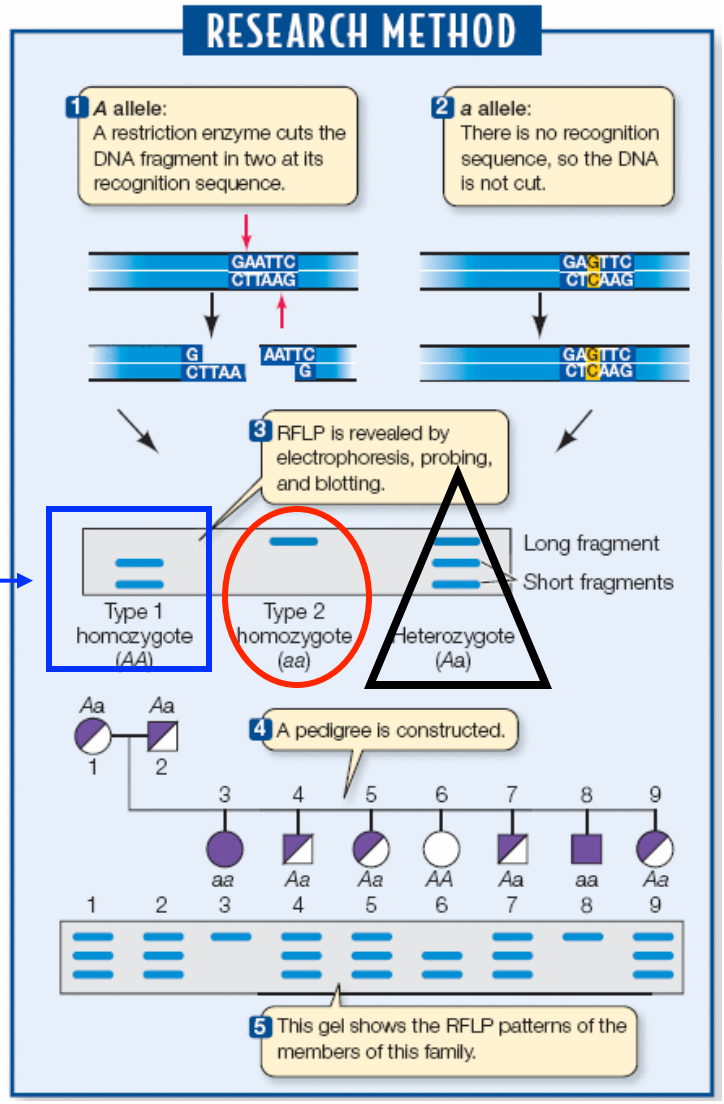
How Know a Clone or Genetically Identical Individual - DNA!





By Using DNA Fingerprints to Identify Individuals & Genes

DNA Fingerprints →



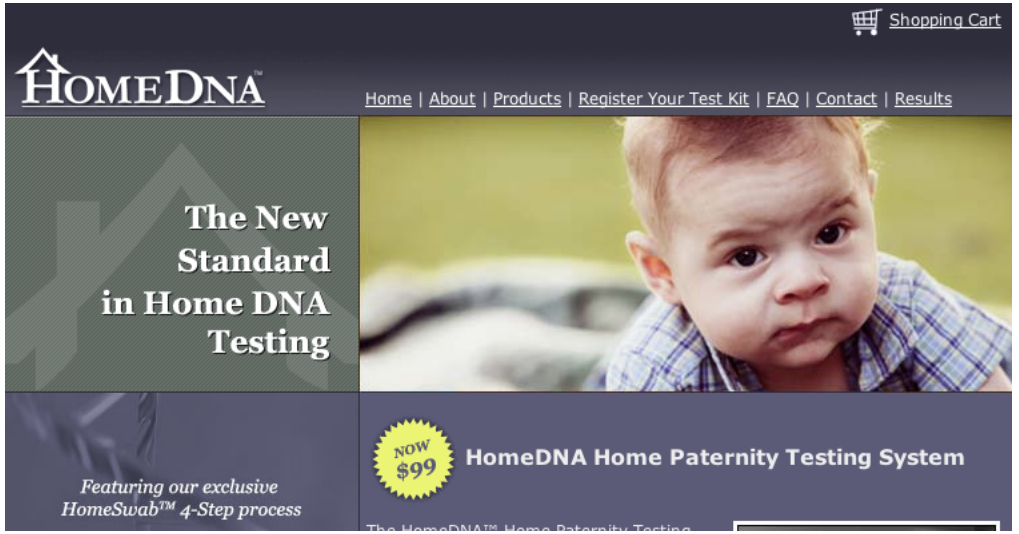
What is YOUR DNA Fingerprint?

DNA Testing Into the Home - Fast & Inexpensive DNA Testing Kits!

Paternity

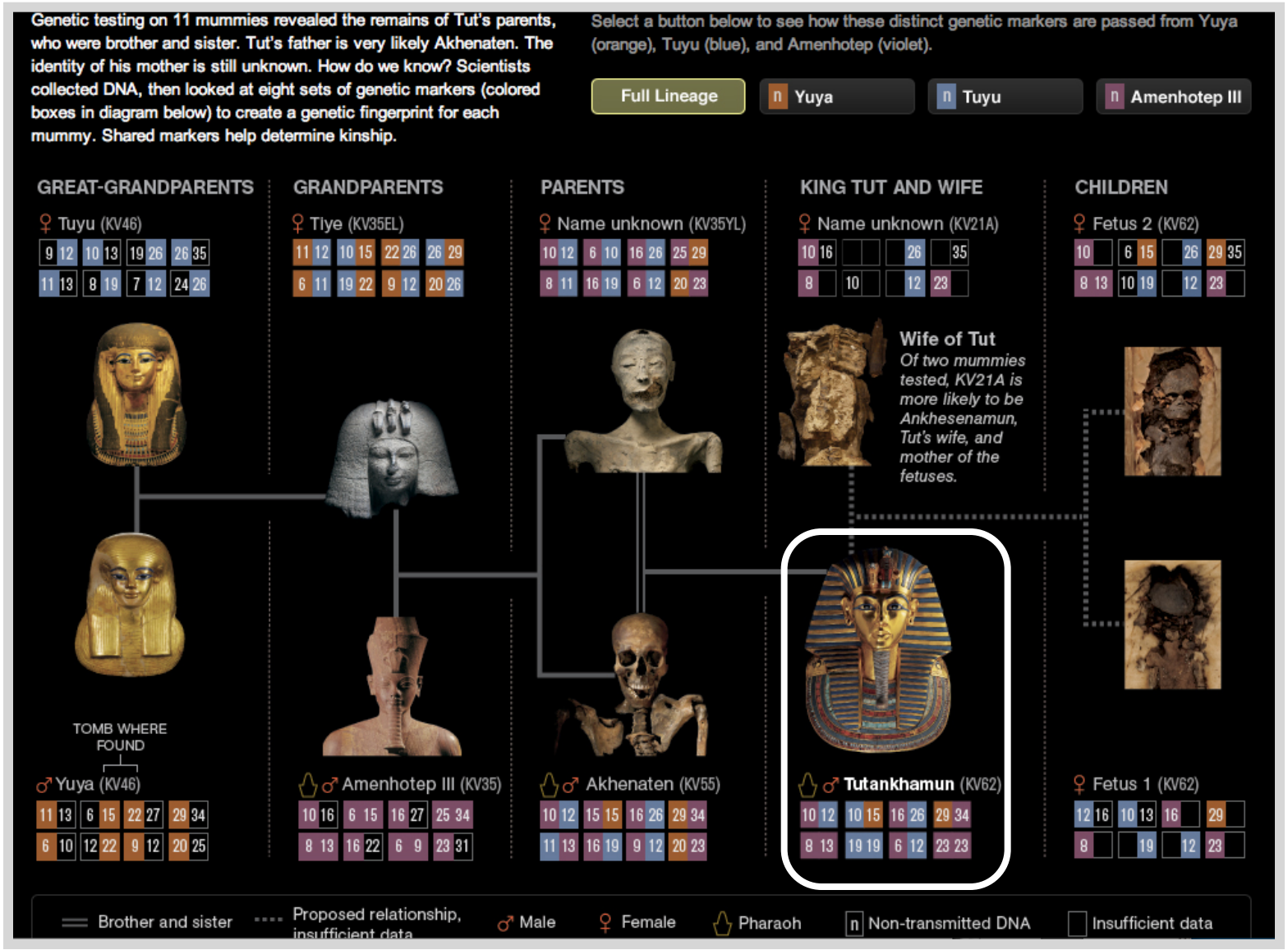
Ancestry

What are the Scientific, Legal, Ethical, & Privacy Issues??



Immigration

Even Lineages of Ancient Mummies Such As King Tut Can Be Determined Using DNA Fingerprinting!!

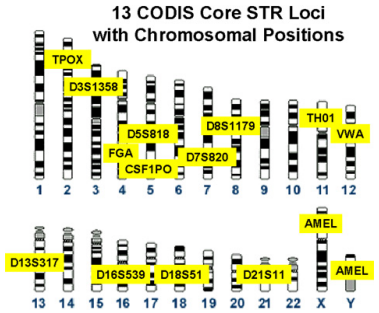


National Geographic, September 2010

King Tut Lived 3,500 years Ago!!

DNA Has Impacted the Law in Dramatic Ways

Combined DNA Index System of DNA Profiles



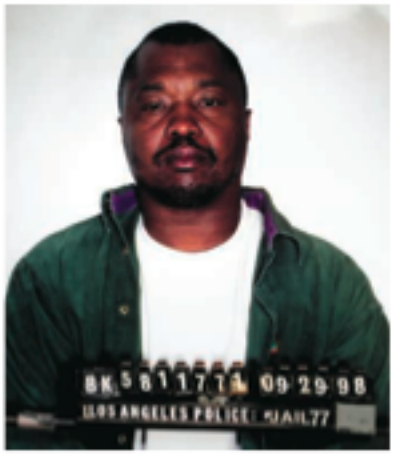
- Convicted Felons
- Suspects Arrested For Felonies
- DNA Samples From Crime Scenes
- Unidentified Human Remains
- Relatives of Missing Persons

July, 2010

Offender Profiles 8,646,417
Forensic Profiles 328,067

FORENSICS

Familial DNA Testing Scores A Win in Serial Killer Case



Proud of their work. A familial DNA search by forensic scientists in California led to the arrest of Lonnie Franklin, the suspected Grim Sleeper killer.

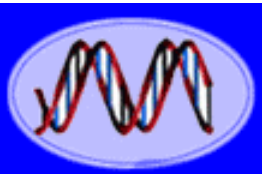
Caught By DNA!!

Set Free By DNA Evidence

INNOCENCE PROJECT

15th Person Cleared by DNA in Dallas. Charles Chatman was released from state custody Jan. 3 in Dallas, after serving nearly 27 years in prison for a rape he didn't commit. He is the 15th Dallas man to be cleared by DNA testing after being wrongfully convicted. After his hearing, he hugged Judge John Creuzot, who advocated for testing in the case. Innocence Project of Texas Attorney Jeff Blackburn (left) represents Chatman.

The Innocence Project is a national litigation and public policy organization dedicated to exonerating wrongfully convicted people through DNA testing and reforming the criminal justice system to prevent future injustice.



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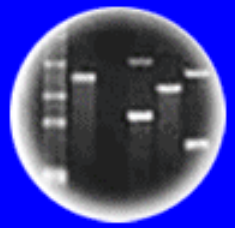

DNA Fingerprinting

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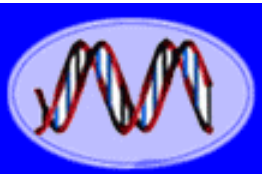
Question Two

Should every individual who is arrested for a crime be required to have their DNA fingerprinted and deposited in a National Criminal DNA database (CODIS)?

a. Yes
b. No



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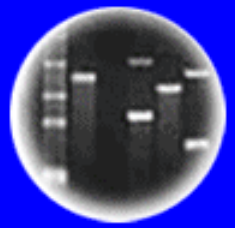

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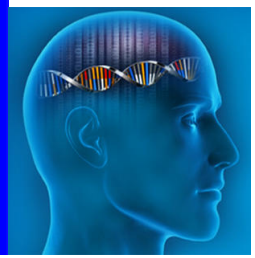
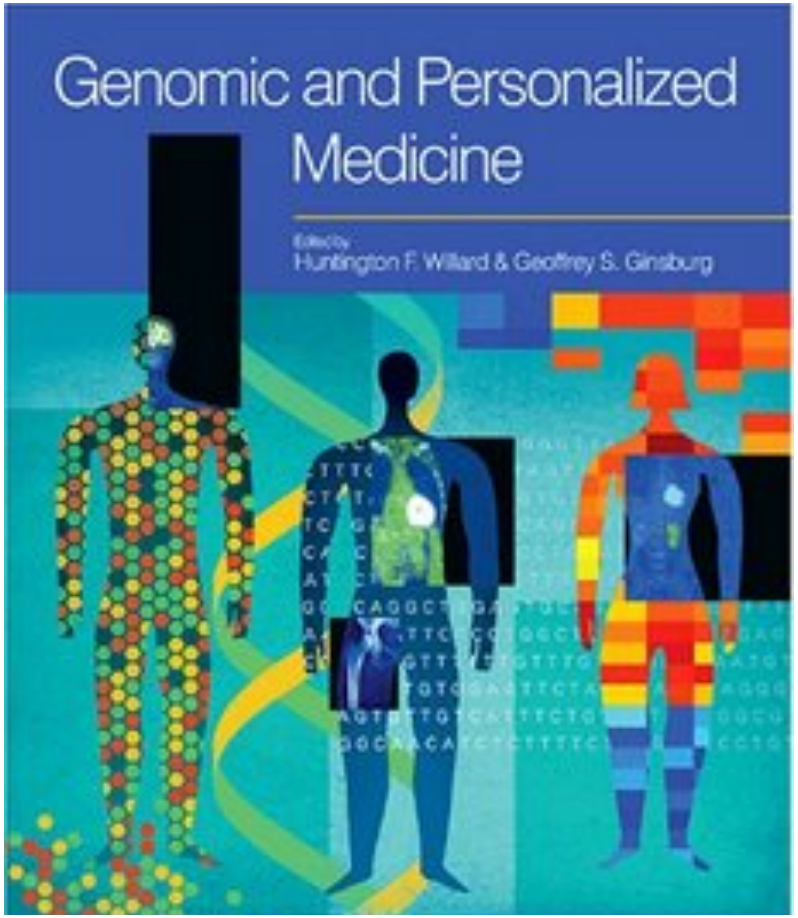
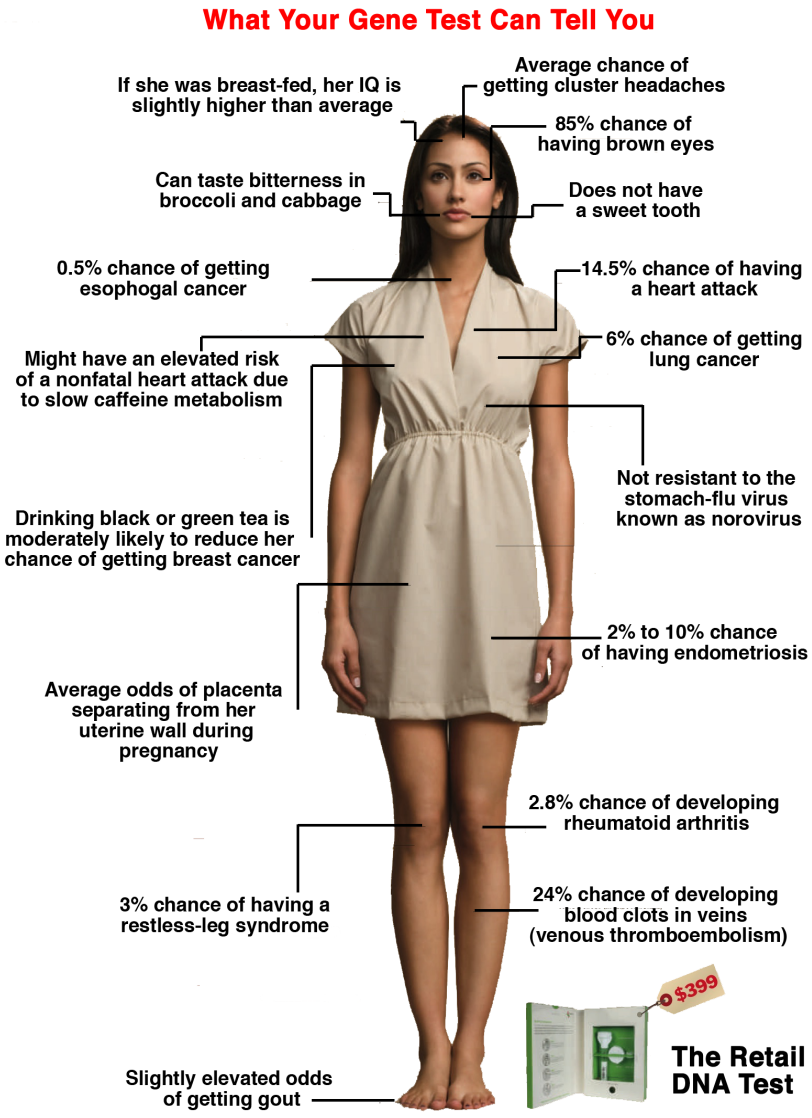


DNA Is Leading to a New Era in Personalized Medicine



DNA Can Be Used To Test For Hundreds of Disease Genes and Human Traits and Generate Personalized Gene Profiles

Time Magazine 2008 - Invention of the Year
Your Personal Genome - 23andMe®



And
Before Birth!!!

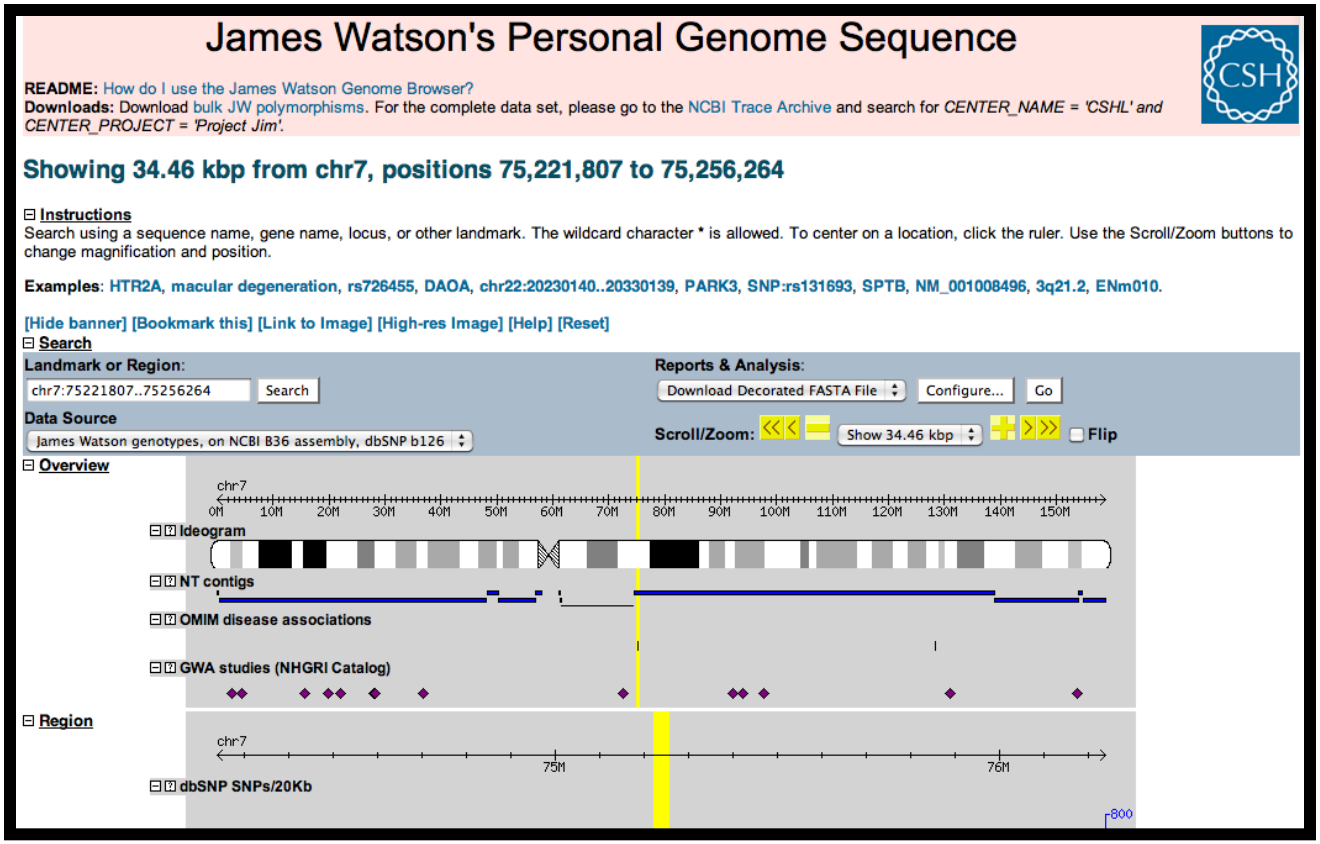
https://www.23andme.com/

Invention Of the Year

The Complete Genome of Individuals Can Now Be Decoded and Sequenced Very Inexpensively ($10,000)!!

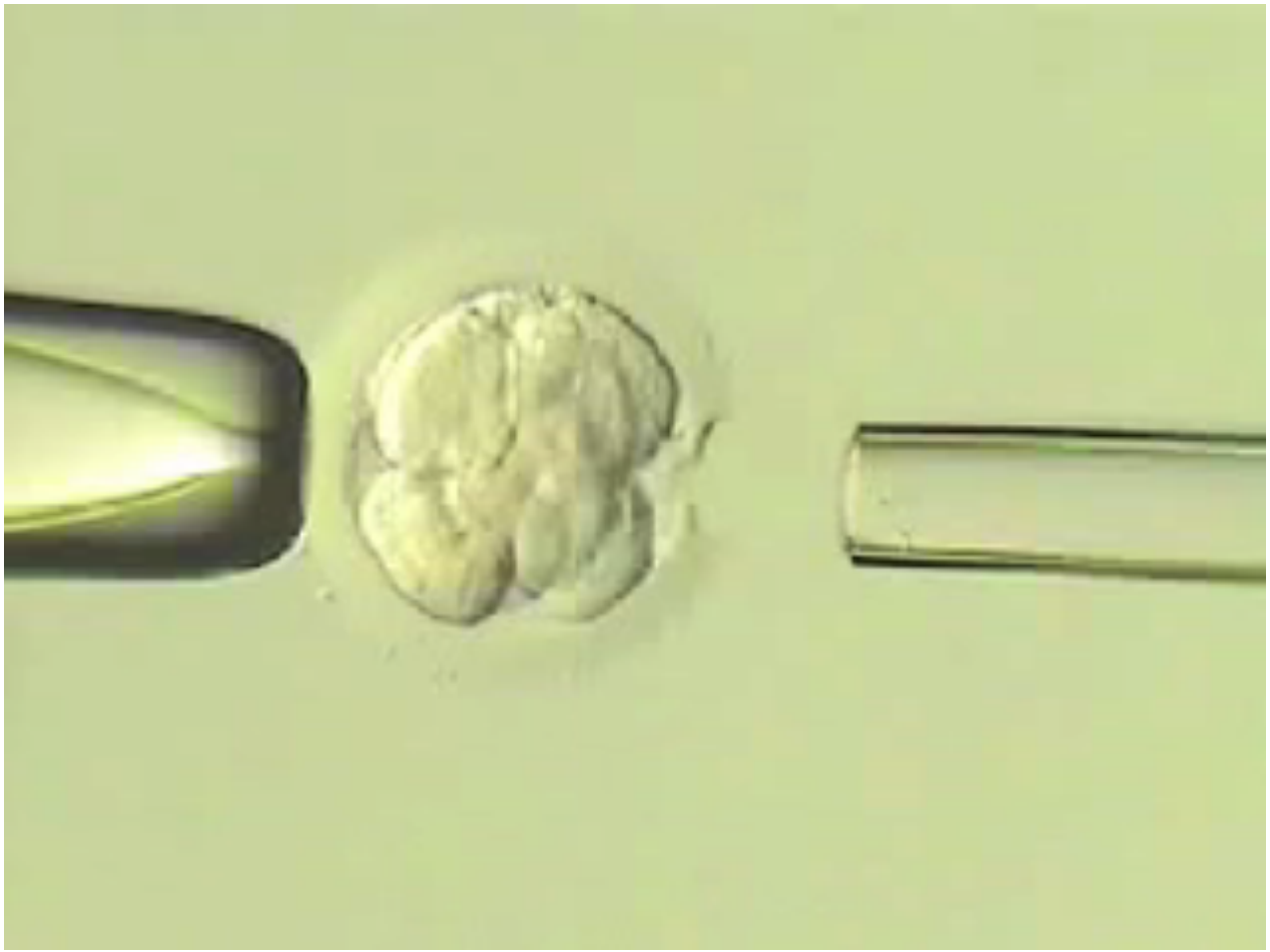
Genome of DNA Pioneer Is Deciphered

By NICHOLAS WADE
Published: May 31, 2007



The Era of Personalized Genomes is Here!

Determining the Genetic Identity of a Human Embryo Before Implantation!



Prenatal Genetic Diagnosis (PGD)

RESEARCH ARTICLE

PRENATAL DIAGNOSIS

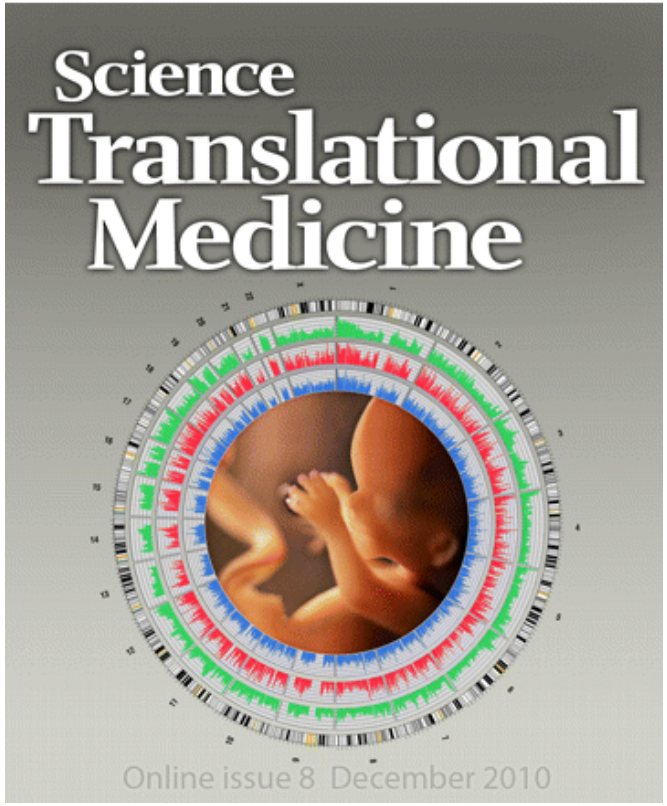
Maternal Plasma DNA Sequencing Reveals the Genome-Wide Genetic and Mutational Profile of the Fetus

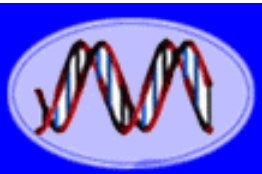
Science Translational Medicine, December 8, 2010 (61,1-12)

Sequencing DNA From the Blood of a Pregnant Woman Allows the Complete Genome Of the Fetus to Be Decoded!

~10% of DNA in Maternal Plasma is From the Fetus

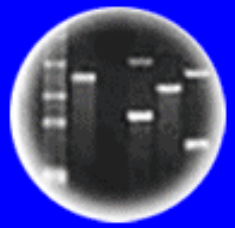
A New Era in DNA Testing!!





DNA
Genetic Code of Life

Entire Genetic Code
of a Bacteria



DNA Fingerprinting

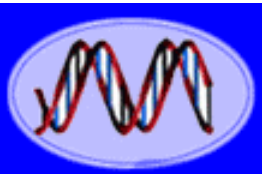
Cloning: Ethical Issues
and Future Consequences

Plants of Tomorrow

Question Three

Should parents that carry a gene for a genetic disease be required to test their children to determine whether they are carriers or have the disease?

a. Yes
b. No



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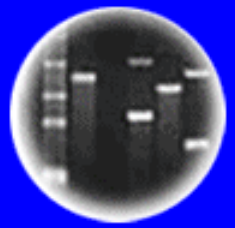

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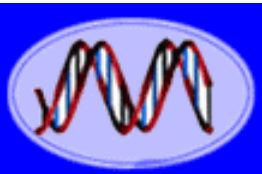
What Is A Gene?

What Do Your Genes Look Like?



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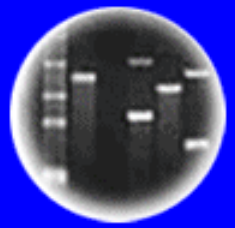

DNA Fingerprinting

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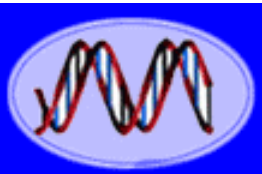
How Was Genetic Engineering Invented?
&
How Did It Lead To All of These Remarkable Advances With DNA?



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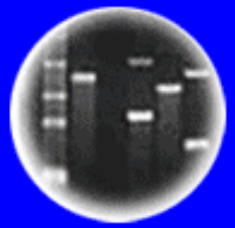

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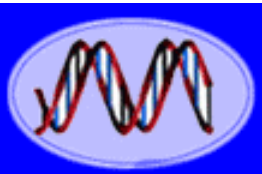
Genetic Engineering Started in a Hawaii Delicatessen 35 Years Ago…..

With An Unexpected "Eureka" Moment Dealing With Two Unrelated Areas of Study:

1. The Mechanism of Bacterial Antibiotic Resistance
2. How Novel Enzymes That Protect Bacteria From Destruction By Viruses "Cut" DNA Into Pieces



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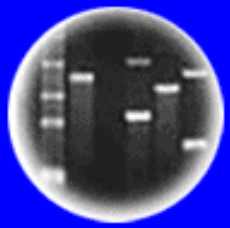

DNA Fingerprinting

Cloning: Ethical Issues
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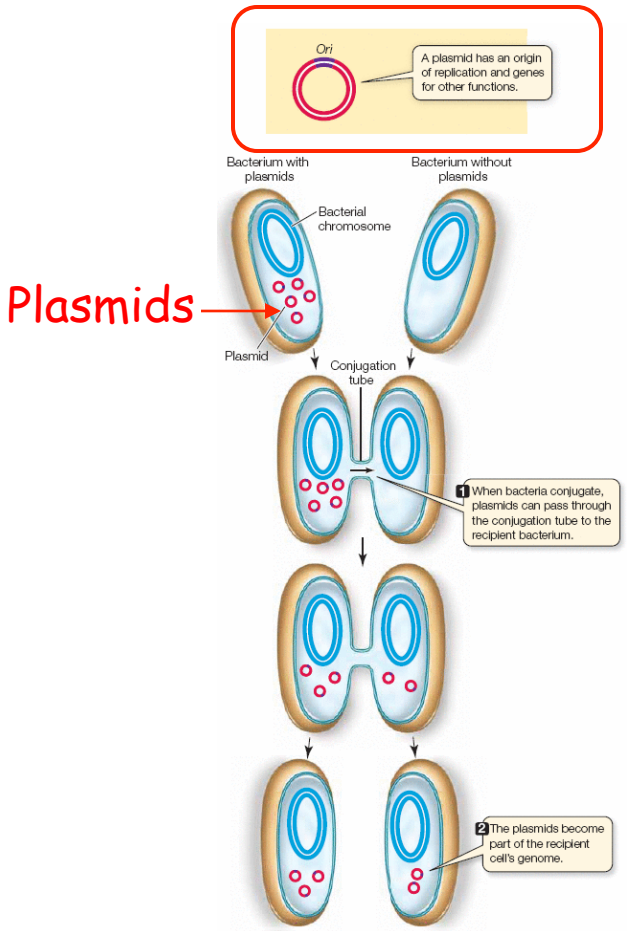
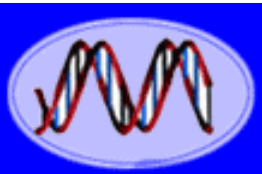
Plasmids Are Circular Self-Relicating DNA Molecules in Bacterial Cells That Carry Antibiotic Resistance Genes



Plasmids Defend Bacteria Against Antibiotics!



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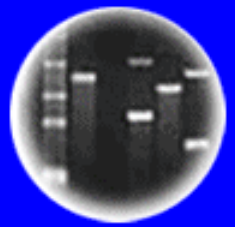


DNA Fingerprinting

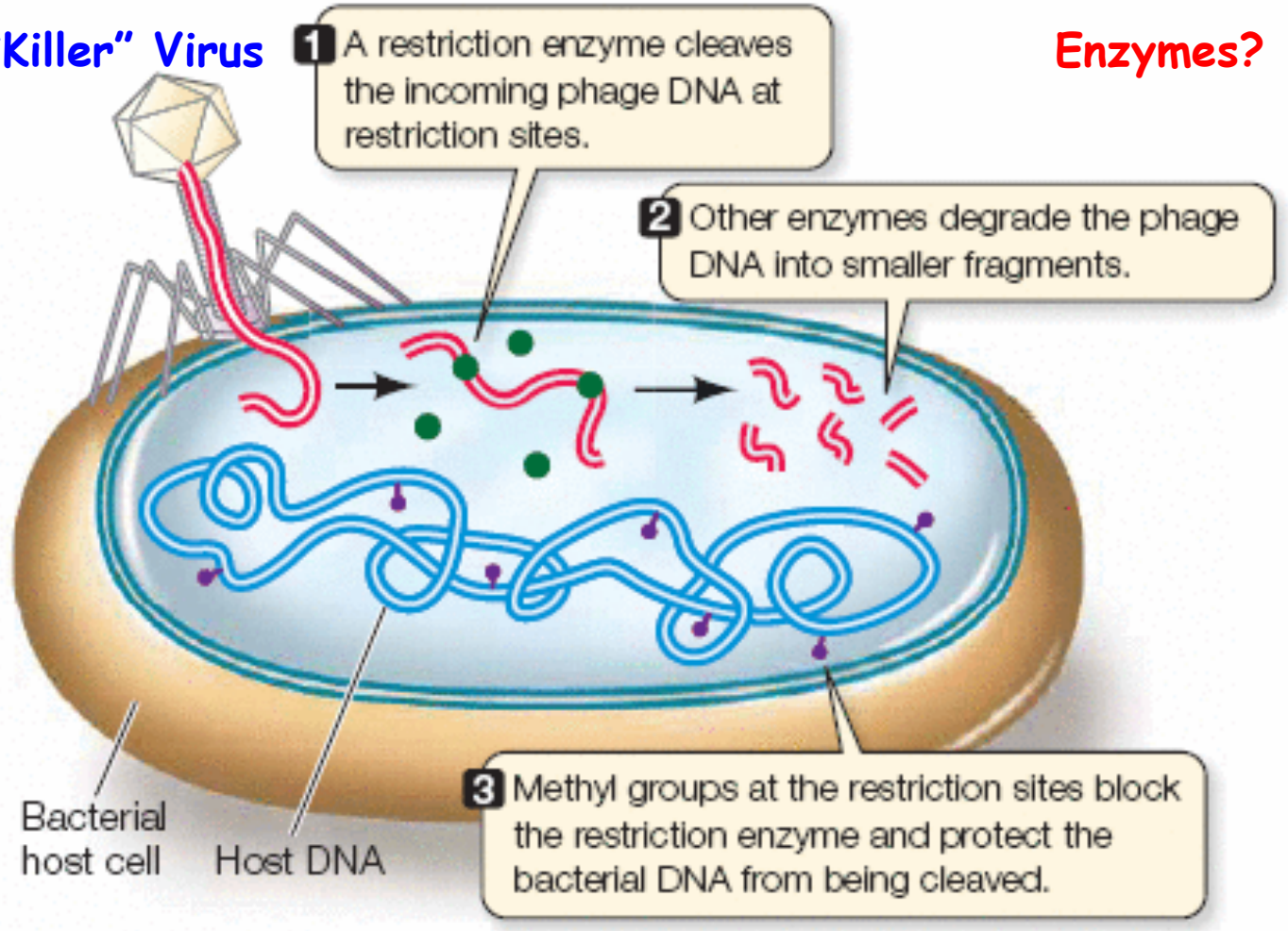
Cloning: Ethical Issues and Future Consequences

Plants of Tomorrow

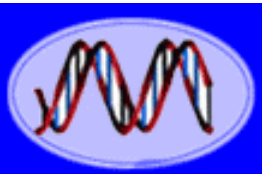
Restriction Enzymes Are Proteins That "Cut" DNA Into Pieces

"Killer" Virus

Enzymes?



Restriction Enzymes Protect Bacteria From "Killer" Viruses!



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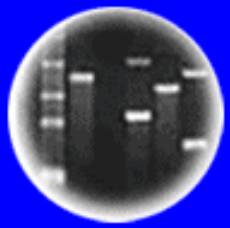
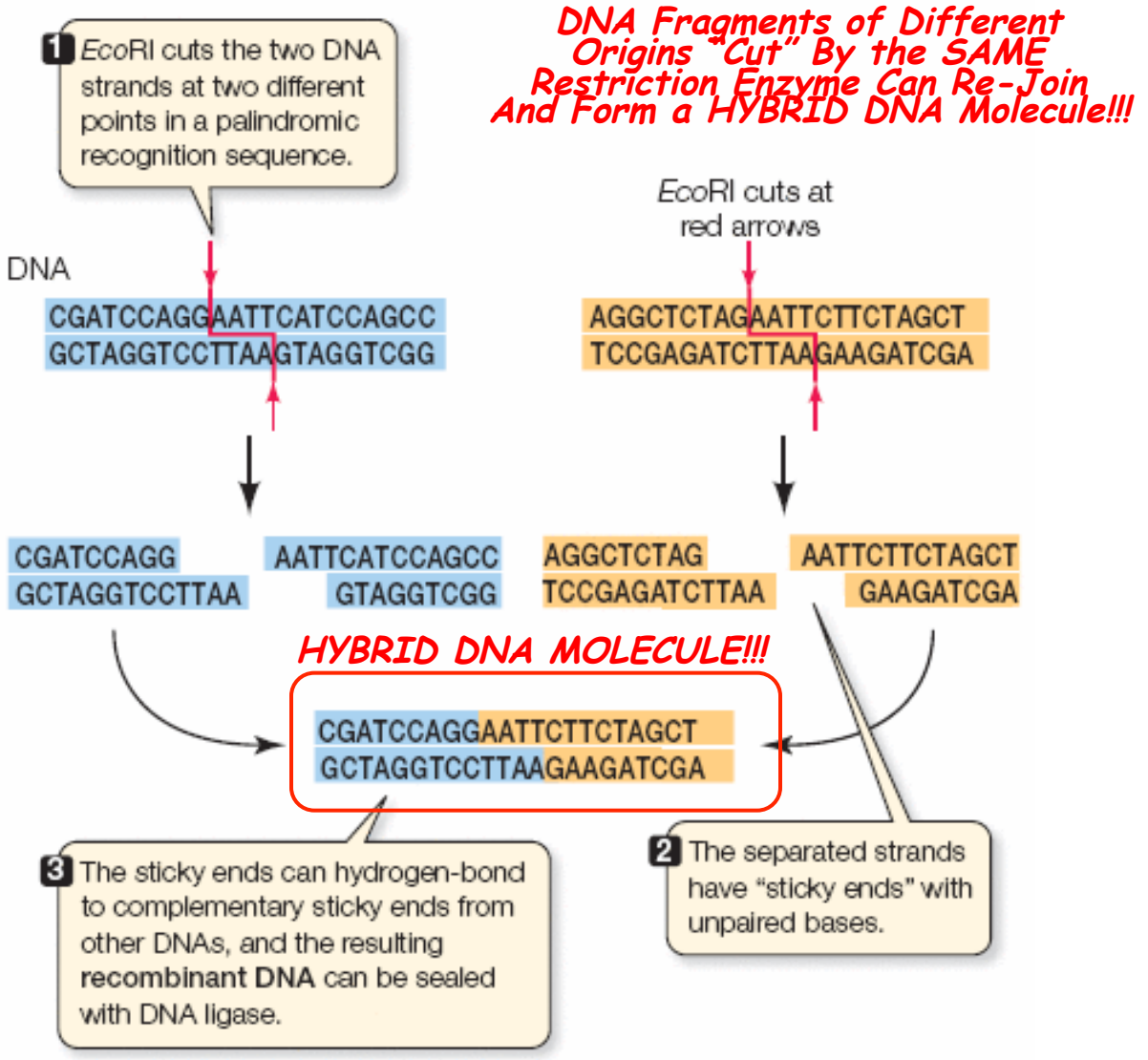


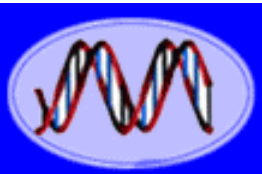
DNA Fingerprinting

Cloning: Ethical Issues and Future Consequences

Plants of Tomorrow

Restriction Enzymes Are Proteins That "Cut" DNA Into Pieces At Specific Sequences





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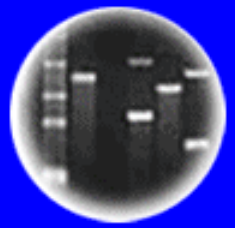
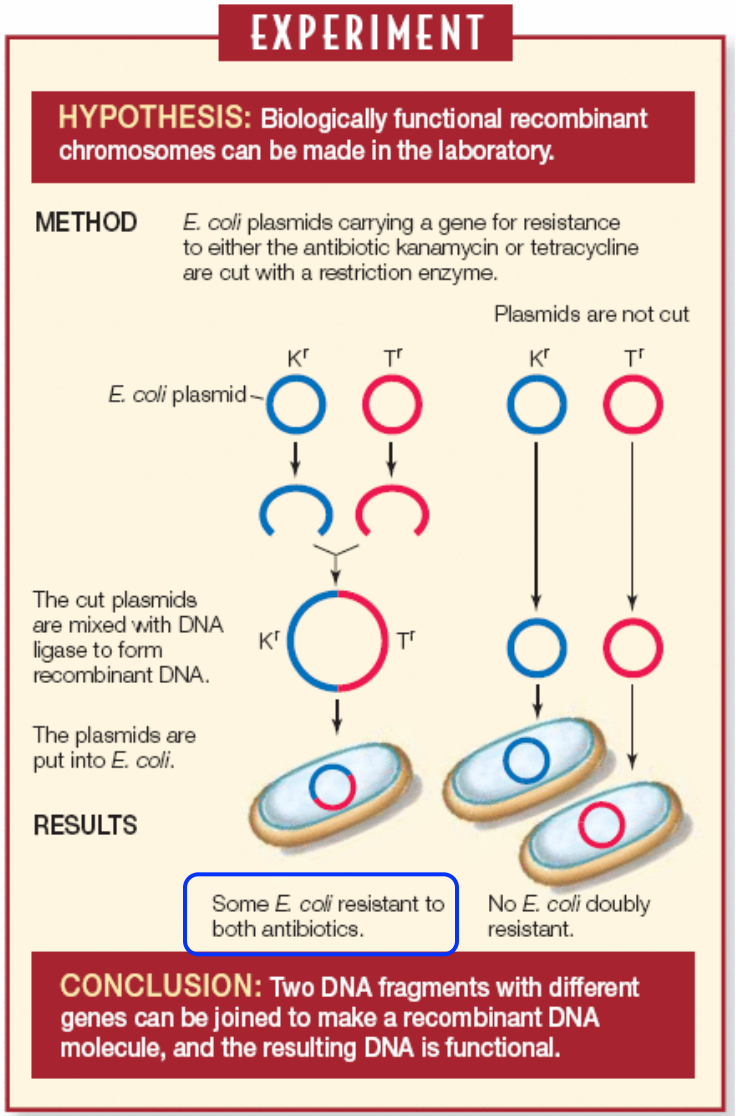


DNA Fingerprinting

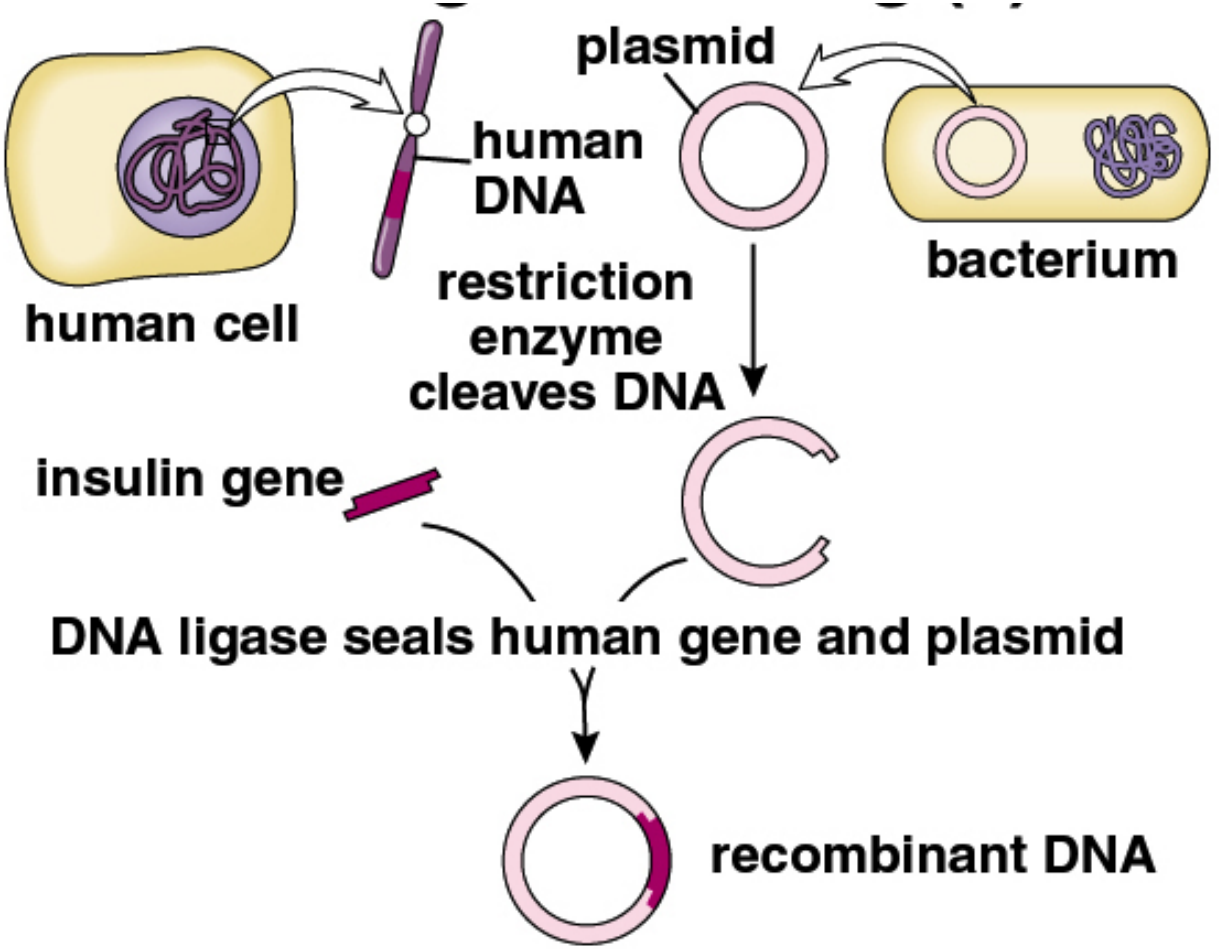
Cloning: Ethical Issues
and Future Consequences

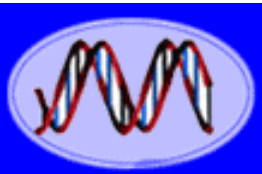
Plants of Tomorrow

Genetic Engineering Technology Can Combine DNA (Genes) From Different Sources Leading to New Gene Combinations!!



The Human Insulin Gene Can Be Separated From Other Human Genes and Cloned in Bacteria Using Recombinant DNA Methods!





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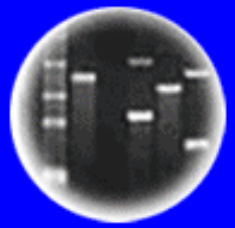

DNA Fingerprinting

Cloning: Ethical Issues
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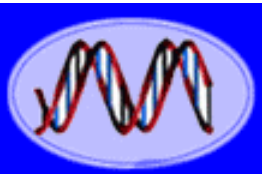
Plants of Tomorrow

Leading to a REVOLUTION in Technology and Making it Possible For the First Time to Isolate, Manipulate, and Study Genes



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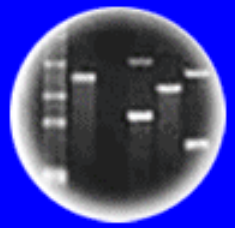

DNA Fingerprinting

Cloning: Ethical Issues
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Plants of Tomorrow

There are Now No Limits to What Can Be Done With Genetic Engineering!

The Genes of Any Organism Can Be Isolated, Combined With Those of Another Organism, and Made to Function Normally in New Cellular Environments!

For Example: Human Genes in Bacteria, Bacterial Genes in Plants, Jellyfish Genes in Monkeys, etc., etc., etc., etc.


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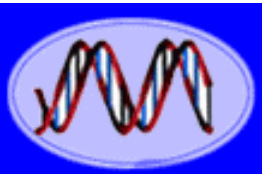

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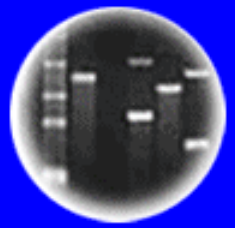

DNA Fingerprinting

Cloning: Ethical Issues
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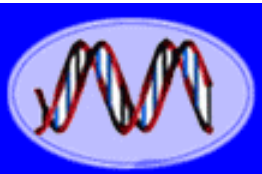
Plants of Tomorrow

What is Genetic Engineering?
&
What Does It Do?



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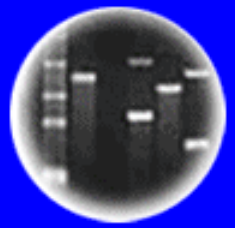

DNA Fingerprinting

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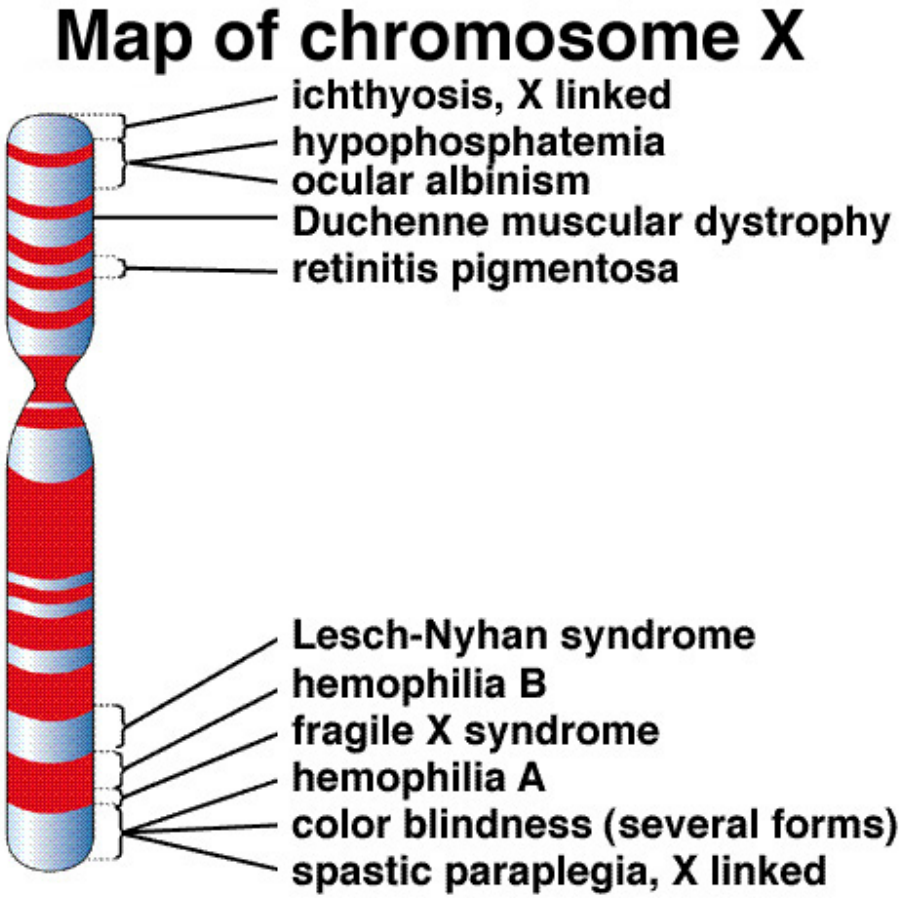
Genomes & Chromosomes Contain Thousands of Genes



How Can a Single Gene Be Studied?

The Era Of DNA Manipulation Means……

1. Specific DNA/Genes Can Be Isolated From Any Organism
2. DNA Segments of Any Kind From Any Organism Can Be Combined
3. Isolated Genes Can Be Re-Inserted Into the Chromosomes of Any Organism and Made to Work
4. Genes and Genomes Can Be Synthesized and Made To Work in Any Organism

There Are No Genetic Limits. All Biological Organisms Use the Same Genetic Rules. The Implications Are Enormous!!

"Why" Clone Genes From An Organism's Genome?

1. PURIFY Individual Genes From the Genome (e.g.,one of 25,000 human genes)
2. AMPLIFY The Gene to Obtain Enough DNA For Study
3. Use the Cloned Gene To:
   a) Study Gene Structure & Function (THE Major Use!)
   b) Use to Convert Cells Into Factories To Make Drugs and Pharmaceuticals
   c) Use to Diagnose Genetic Diseases
   d) Use to Identify Individuals (e.g., paternity, forensics)
   e) Use to Correct Genetic Disease
   f) Use to Engineer New Crops and Farm Animals
   g) Synthesize New Genomes and Many Other Uses

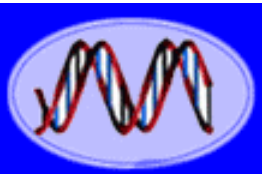
Genetic Engineering Has Lead to New Knowledge About How Cells and Genes Function and Has Lead to Applications That Have Improved Our Lives!!

The Age of DNA & Genetic Engineering Has Affected Our Lives in Many Ways

1. Basic Understanding of Living Processes and Ourselves
2. Basic Understanding of Genes and Their Functions
3. The Era of Genomics and the Sequence of the Human Genome and Those of Other Organisms
4. Basic Understanding of Human Diseases Such as Cancer and Novel New Treatments
5. A Multibillion Dollar Biotechnology Industry
6. New Legal Issues Such as Genetic Privacy, Forensics, and Patents on Genes and Genetically Engineered Organisms
7. An New Understanding of Human Origins and the Diversity of Human Populations (e.g., where we come from)
8. New Understanding of the Evolutionary Relationships Between Organisms (e.g., sequence of mammalian genomes, including mouse, human, dog, cat,chimpanzee)
9. Ability to Sequence the Genomes of Extinct Organisms
10. New Ethical Issues in "How Far" We Should Go in Using Genetic Engineering Technology

Genetic Engineering Technology Has Led to Many New Legal and Ethical Issues

1. Patenting Genes, Cells, & Living Organisms?
2. Regulating Experimentation on DNA, Cells, Transgenic Organisms ("GMOs")?
3. Regulating the Release of Genetically Modified Organisms into the Environment?
4. Labeling of Genetically Modified Foods?
5. Genetic Testing: DNA Databases, Newborn Genetic Screening, Genetic Privacy, Involuntary or Voluntary Testing?
6. Genetic Discrimination?
7. Genetic Enhancement and Eugenics: Right to Enhance Your Child?
8. Gender Selection and Prenatal Diagnosis of Genetic Diseases?
9. Gene Therapy: Correcting Human Genetic Diseases?
10. Human Cloning and Genetic Improvement?
11. Gene Testing Companies (e.g., 23andMe): Liability?
12. Synthetic Genomes: Constructing New Organisms?



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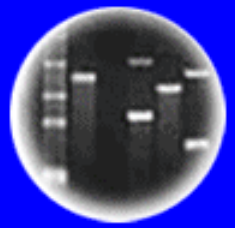

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What Can Be Done?

A Few Examples!

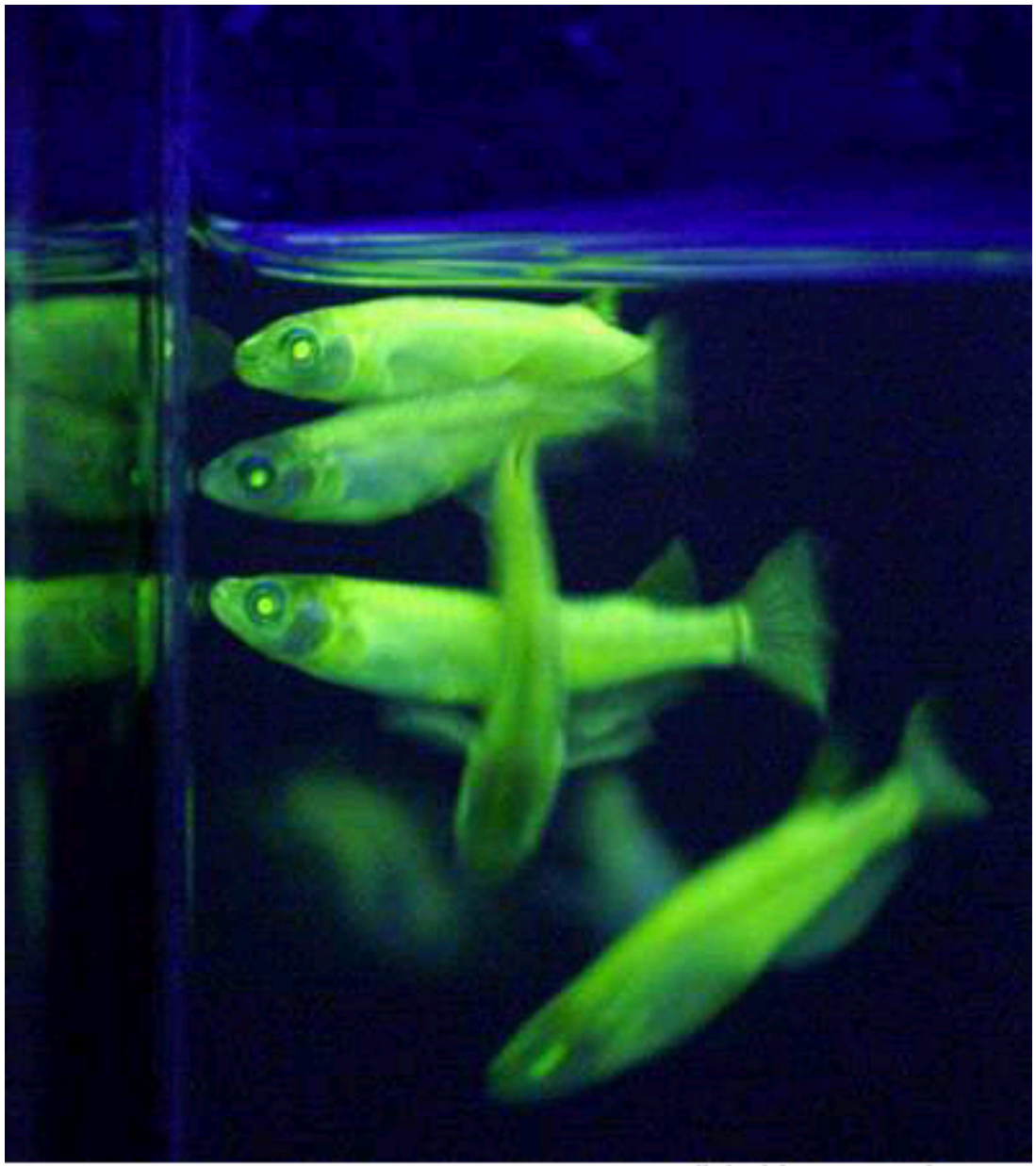
Using a Jellyfish Gene to Make Animals and Plants Glow!!!!

Green Fluorescence Protein


Making a "GloFish".....
.....Using Genetic Engineering &
A Jellyfish Gene!!!!


A "GloFish" Embryo!!!!!

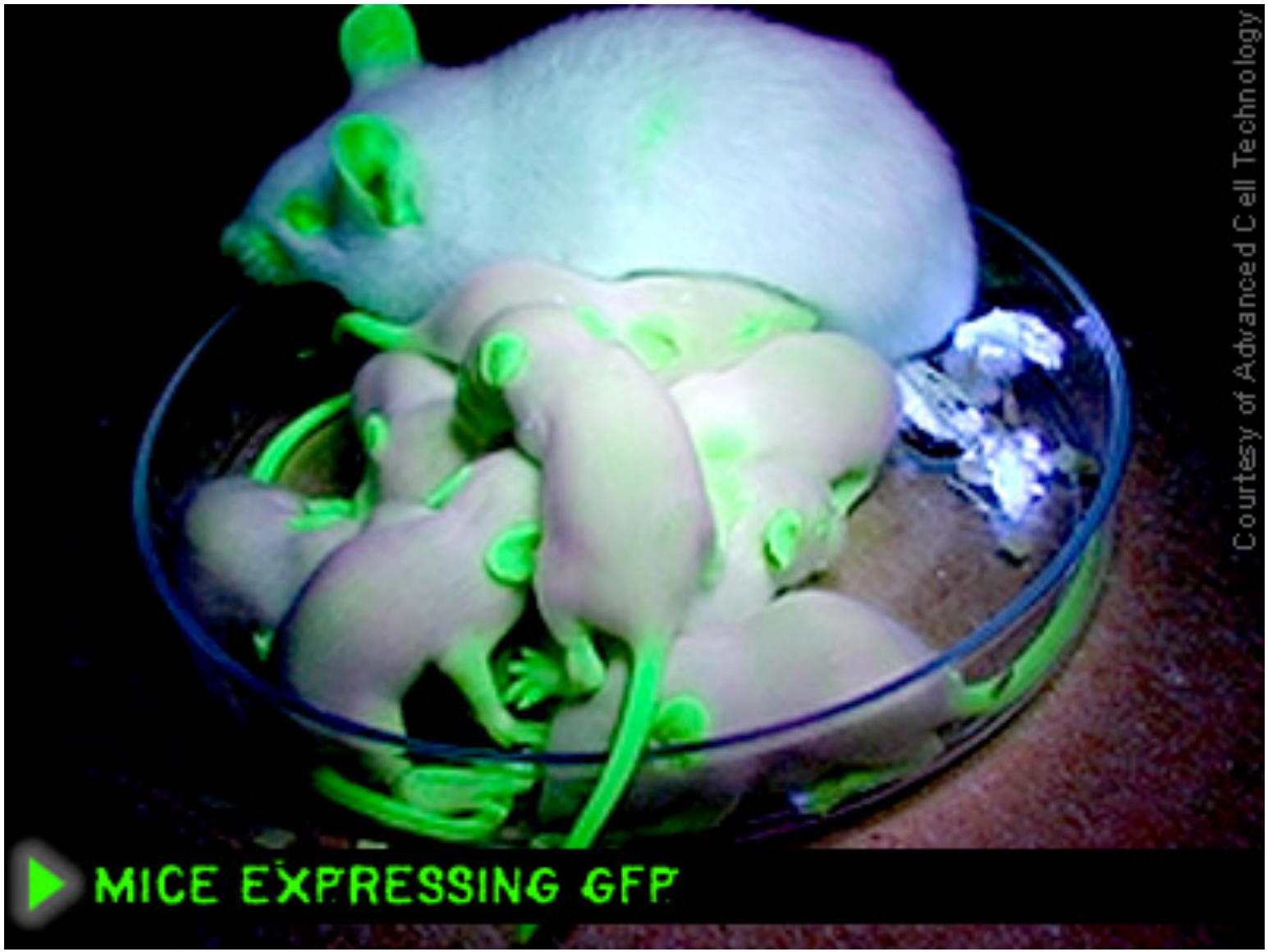
A "GloFish!!!!!"



GloFish Fluorescing With Different Colors!!

How About a GloFly!

What About "GloMice!!!"



What About Glo Monkeys, Cats and Pigs!!

And a GloPlant With the Same Jellyfish Gene!!!

What are the Philosophical and Biological Implications of These Experiments?

Genetically Engineered Organisms

From Lab to Kitchen | The menu of gene-altered foods is expanding

Modified foods in grocery stores today...

CORN

Corn or corn-derived products can be found in oil, breakfast cereal, bread

SOYBEANS

Soybeans are used in tofu, soy milk, soy nuts

SUGAR BEETS

Sugar derived from the beets goes in bread, cereal, candy

...and foods that may be coming to your plate soon

SALMON

The genetically engineered AquAdvantage salmon (background) grows twice as fast as an Atlantic salmon of the same age (foreground).

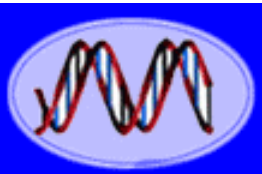
RICE

In China, designed to be insect resistant

PIGS

In Canada and the U.S., designed to better digest and process phosphorus, a major source of pollution

Source: WSJ research; Note: Photos are meant to be representational and do not necessarily depict specific genetically-modified foods
Photos: Bloomberg News (corn); Associated Press (soybeans); DPA/Zuma Press (sugar beets); Reuters (salmon and rice); Agence-France Press/Getty Images (pigs)



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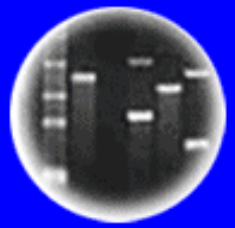

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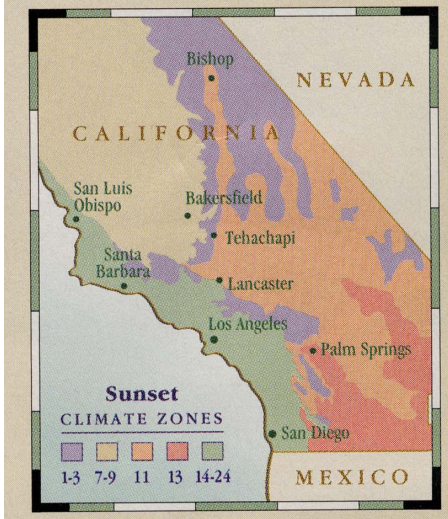
What About Inserting Bacterial Genes Into Plants To Produce a Result With Significant Applications??

GARDEN | GUIDE

SUNSET

WHAT TO DO IN YOUR GARDEN IN SEPTEMBER

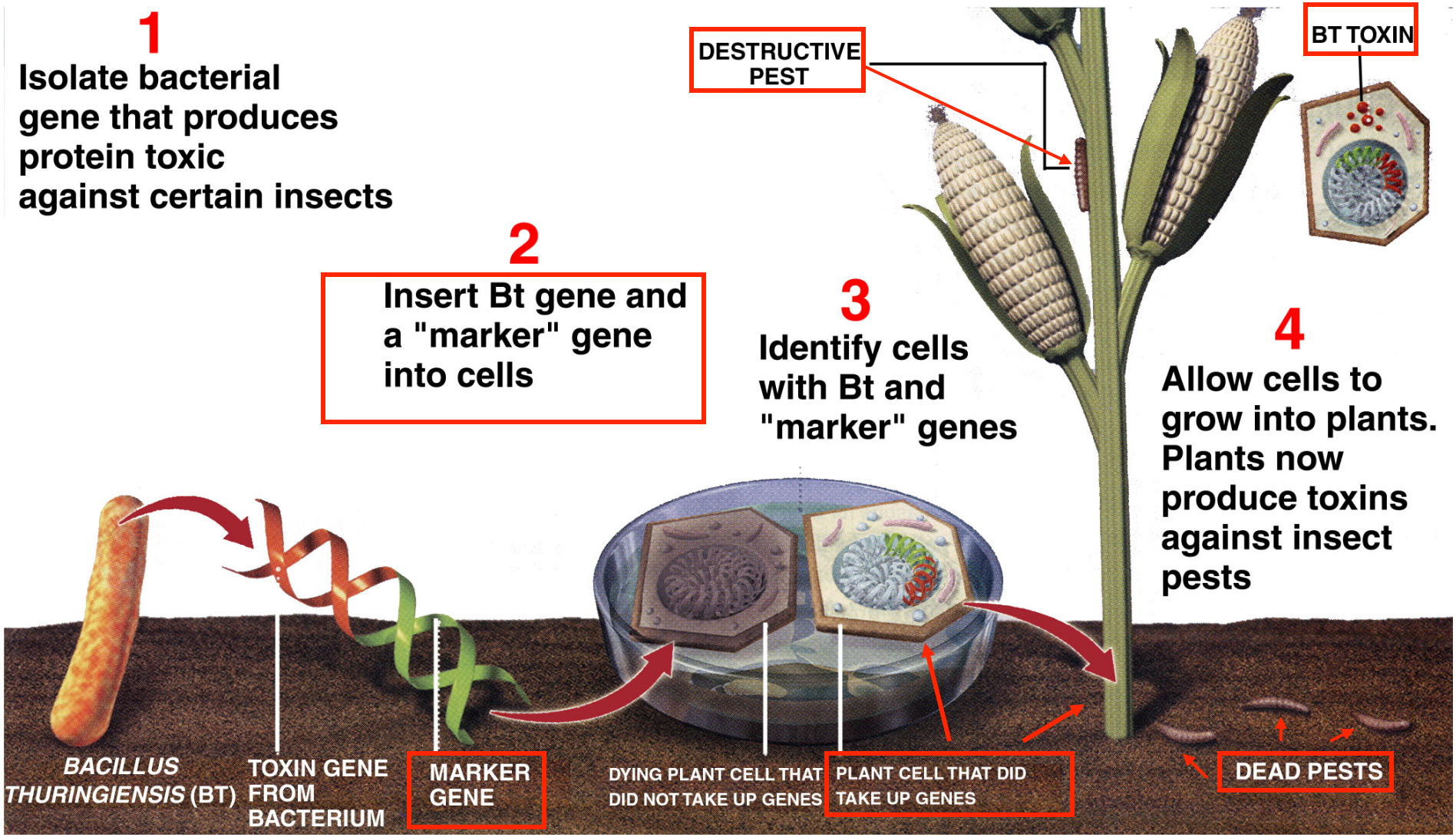
Southern California Checklist



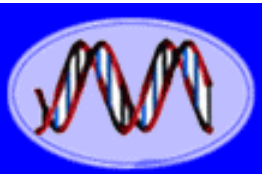
DEBRA LAMBERT

✔ **PROTECT CABBAGE CROPS.** The minute you plant a brassica, squadrons of cabbage white butterflies seem to descend on it to lay their eggs. The easiest way to thwart them is to cover your cabbage crops with row covers right from the start. The next best option is spraying with *Bacillus thuringiensis* to kill the young caterpillar larvae. ◆

How to Make an Insect-Resistant Plant



Genetic Engineering a Plant to Resist Worms!



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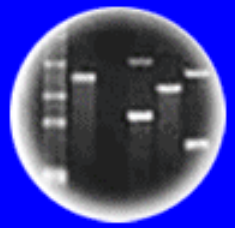

DNA Fingerprinting

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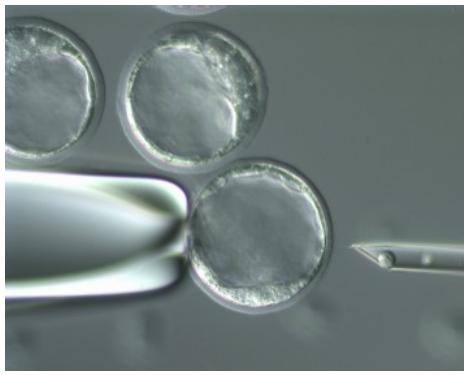
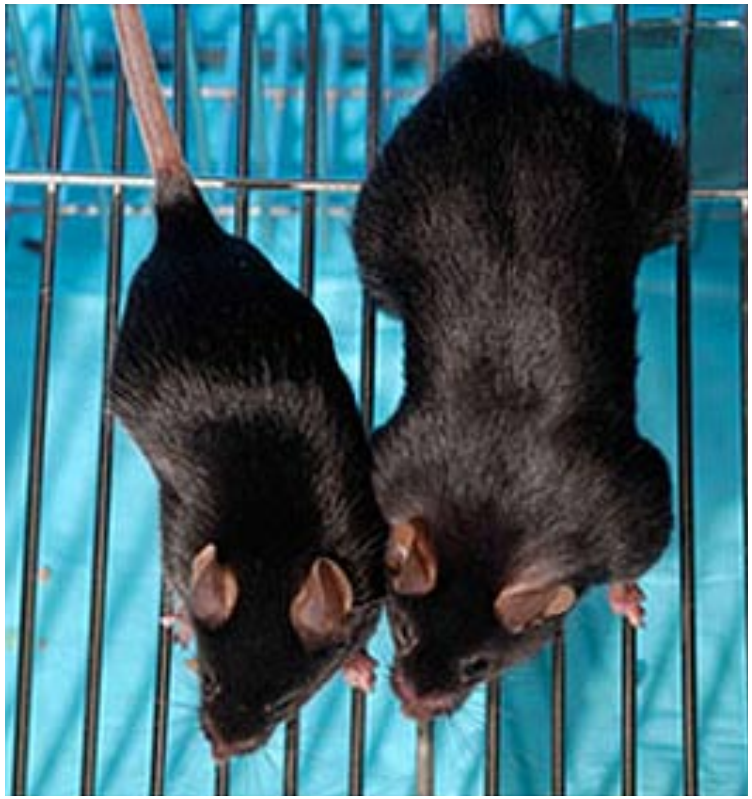
What Else Can Be Done With Genetic Engineering?

Engineering "Mighty Mouse" With a Rat Growth Hormone Gene





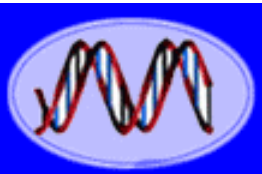
How About a Giant Fish?

THE WALL STREET JOURNAL.
WSJ.com

BUSINESS | SEPTEMBER 21, 2010

Gene-Altered Fish Closer to Approval

By GAUTAM NAIK



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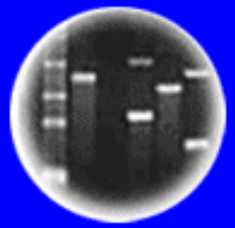

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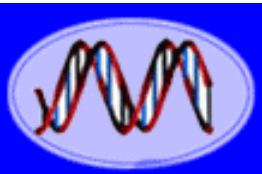
Question Four

Would you eat food obtained from genetically modified plants and animals?

a. yes
b. no



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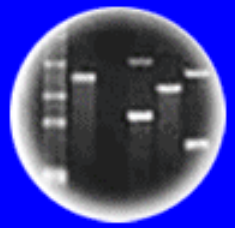

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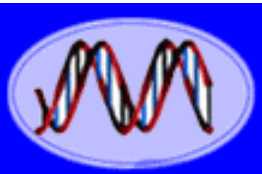
Question Five

Have you ever eaten genetically engineered food?

a. Yes

b. No



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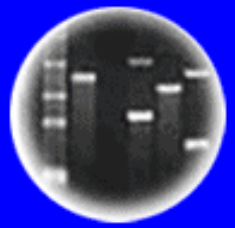

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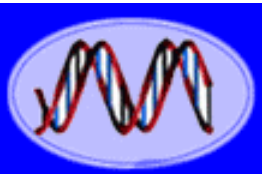
Question Six

Should genetically modified foods be labeled?

a. Yes

b. No



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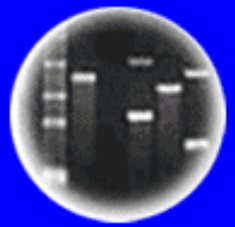

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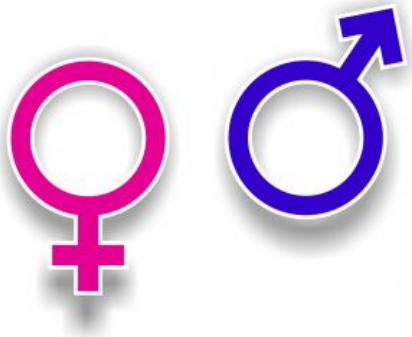
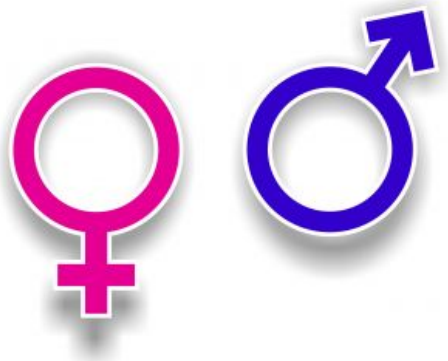
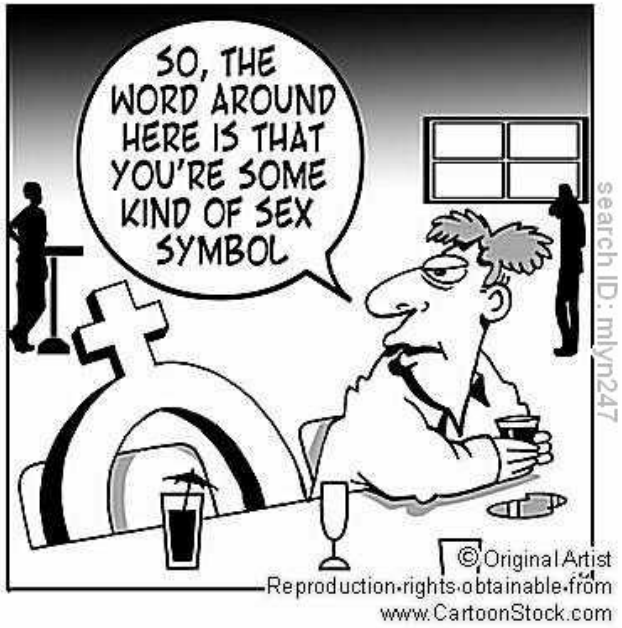
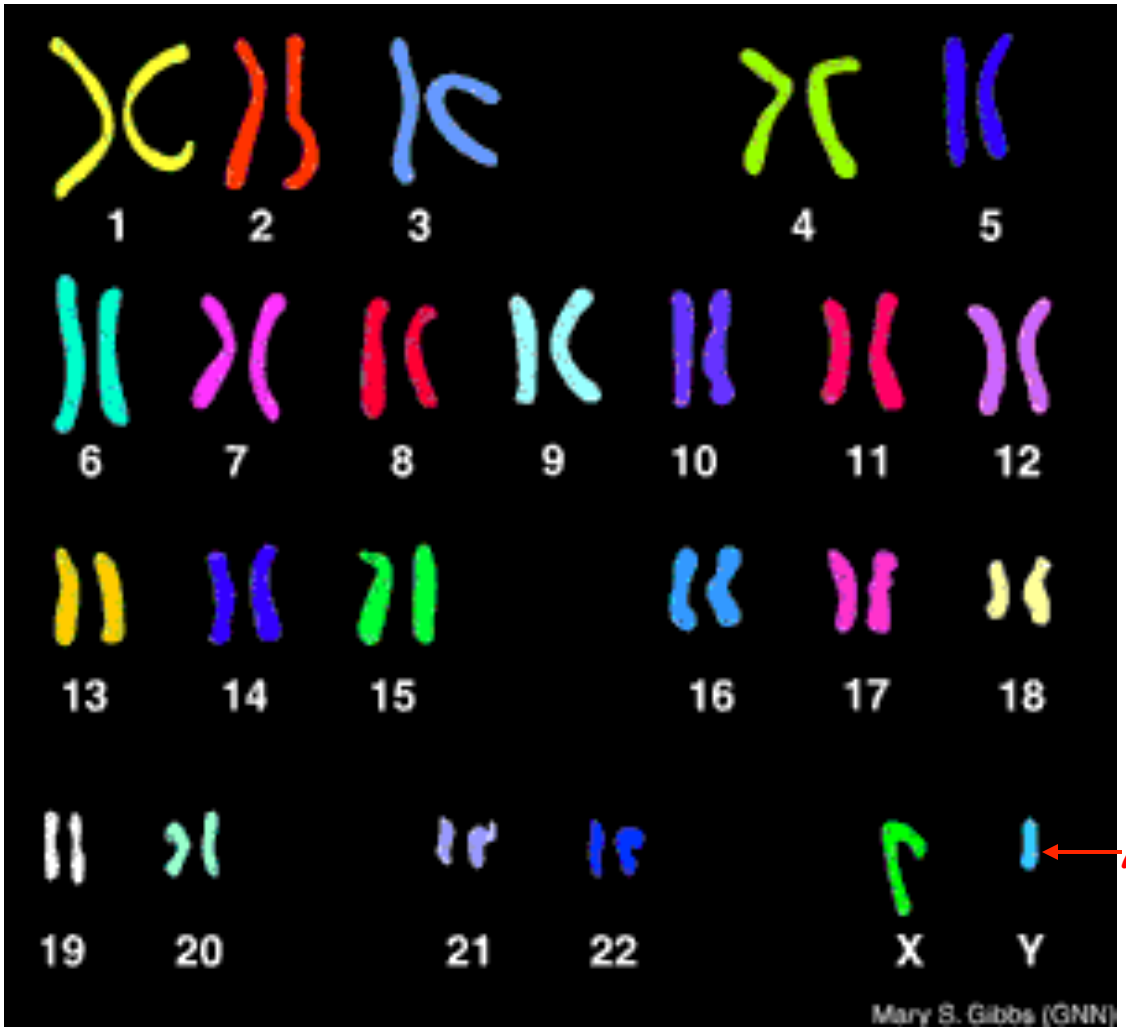




How About Changing The Sex Of An Organism?



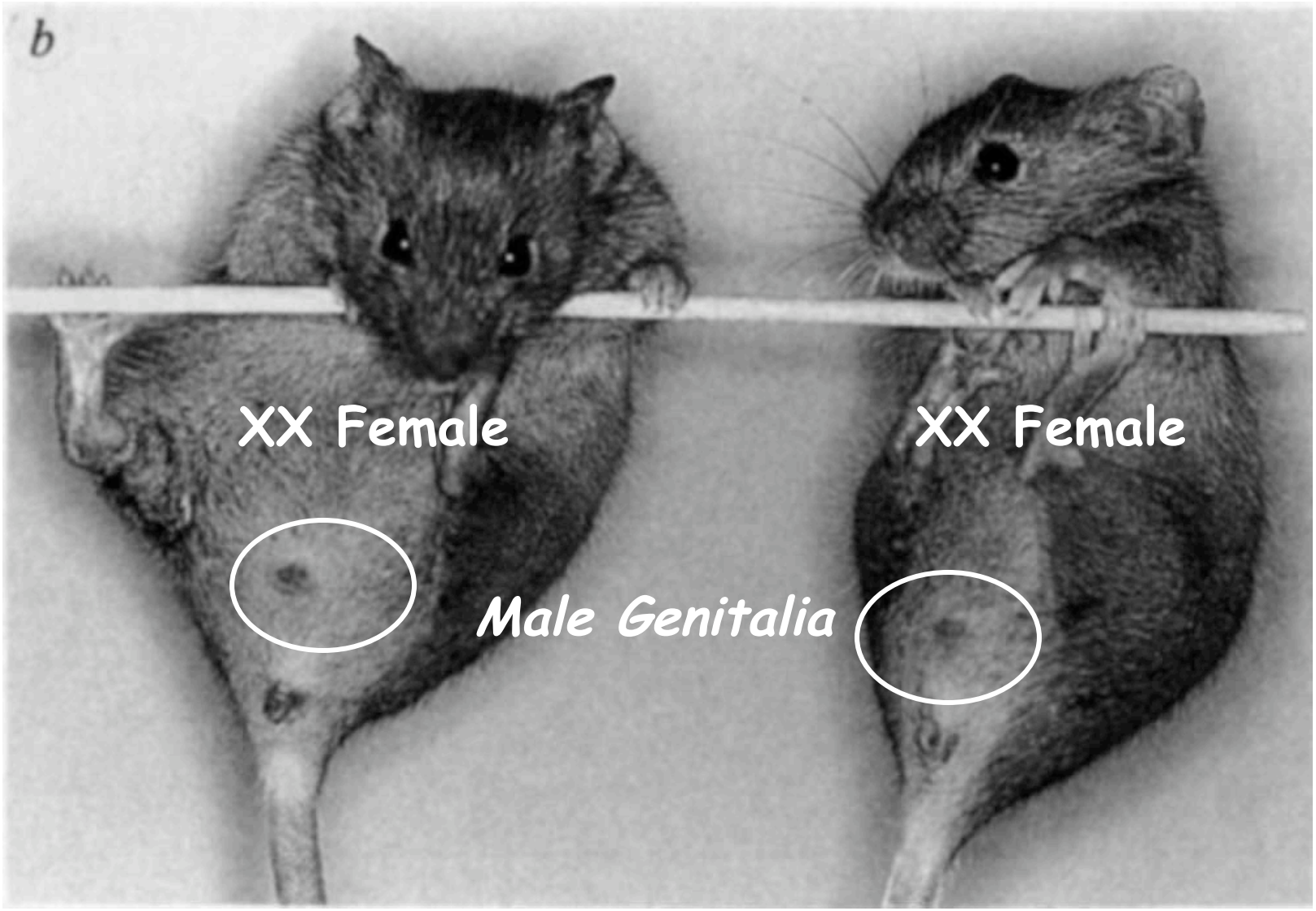
Males and Females Differ By the Presence or Absence Of the Y Chromosome (simplistically!!)



Male SRY Gene
(Sex Determining Region Y)

The Human SRY Gene For Maleness Can…….

…..Turn a Female Mouse Into a Male!!!!

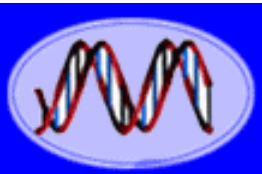


What Does This Experiment "Say" About Human & Mice Genes?

What Are the Conclusions of This Experiment?

- *Ground State of Mammalian Development is FEMALE!*
- *ONE Gene Switches Development From Male to Female!*
- *Eve Had a Y Chromosome and LOST the SRY Gene!!*

"So the LORD God caused a deep sleep to fall upon the man, and while he slept took one of his ribs and closed up its place with flesh; and the rib which the LORD God had taken from the man he made into a woman and brought her to the man. Then the man said, "This at last is bone of my bones and flesh of my flesh; she shall be called Woman, because she was taken out of Man." *Genesis, Chapter 2*



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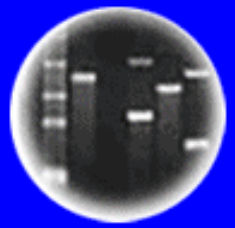

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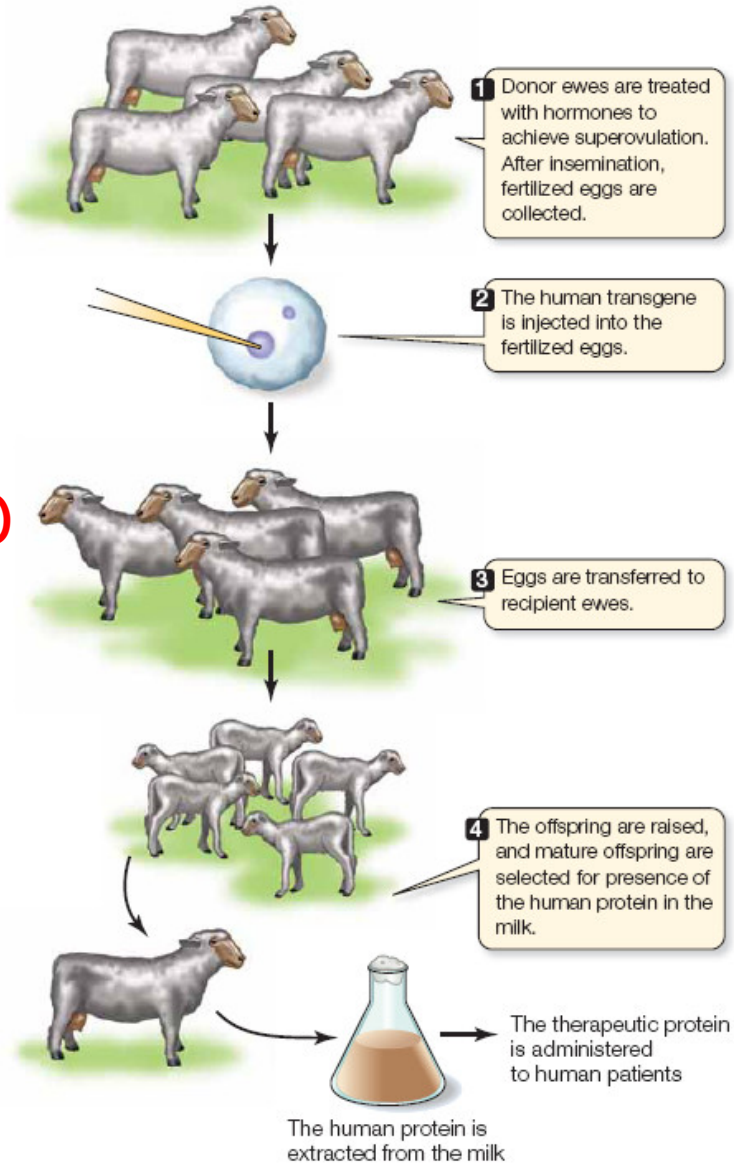
Engineering Goats to Make Specific Human Proteins That Can Be Used to Treat Diseases

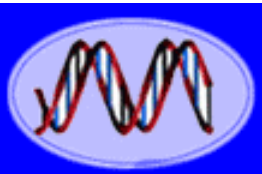
Making TPA (Tissue Plasminogen Activator) in Goat Milk to Treat Heart Patients



Genetically Engineered Drugs to Treat Human Diseases

Some Medically Useful Products of Biotechnology

PRODUCT	USE
Colony-stimulating factor	Stimulates production of white blood cells in patients with cancer and AIDS
Erythropoietin	Prevents anemia in patients undergoing kidney dialysis and cancer therapy
Factor VIII	Replaces clotting factor missing in patients with hemophilia A
Growth hormone	Replaces missing hormone in people of short stature
Insulin	Stimulates glucose uptake from blood in people with insulin-dependent (Type I) diabetes
Platelet-derived growth factor	Stimulates wound healing
Tissue plasminogen activator	Dissolves blood clots after heart attacks and strokes
Vaccine proteins: Hepatitis B, herpes, influenza, Lyme disease, meningitis, pertussis, etc.	Prevent and treat infectious diseases



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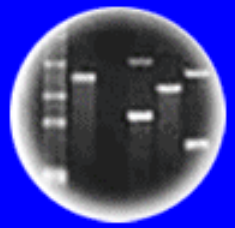

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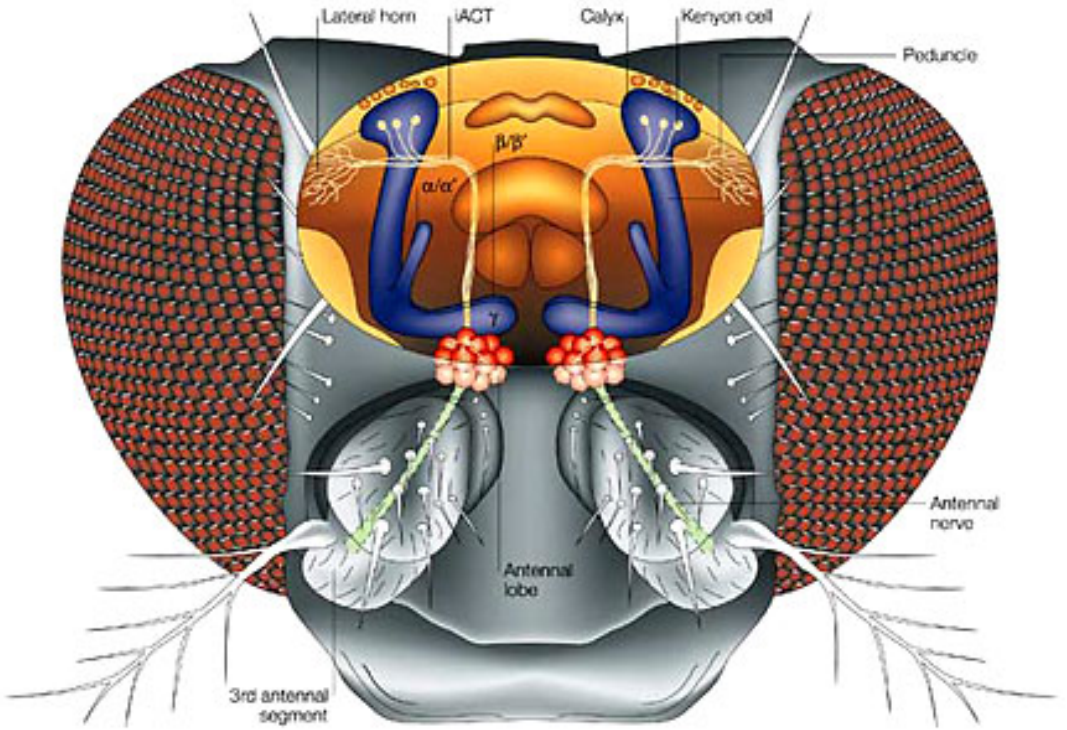
Question Seven

Would You Use a Genetically Engineered Drug?

a. Yes
b. No

Engineering Memory in a Fly!

Researchers Create Artificial Memories in the Brain of a Fruitfly

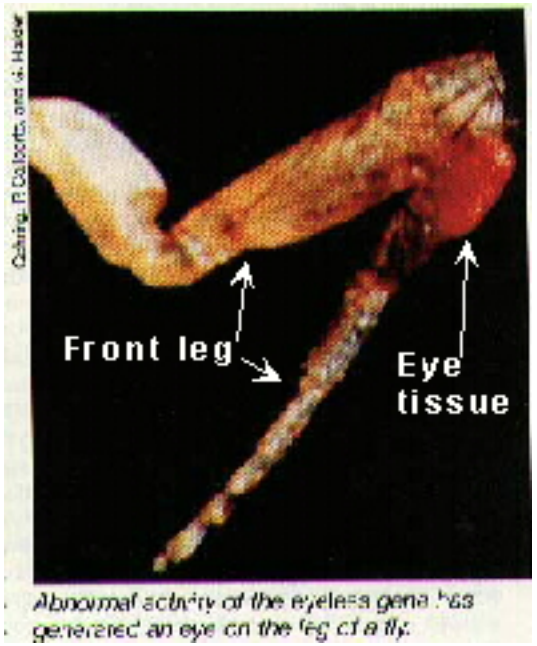


NATURE

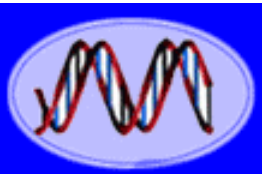
SMALL MINDS Using genetic manipulation and light beams scientists created a memory in a fly's brain that made a tennis shoe smell something to avoid.

By NICHOLAS WADE
Published: October 19, 2009

Changing Body Architecture- Engineering Eyes on a Fly's Leg With a Single Gene!



Abnormal activity of the eyeless gene has generated an eye on the leg of a fly.



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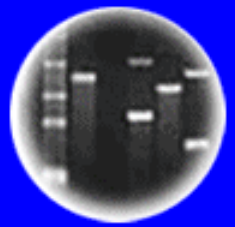

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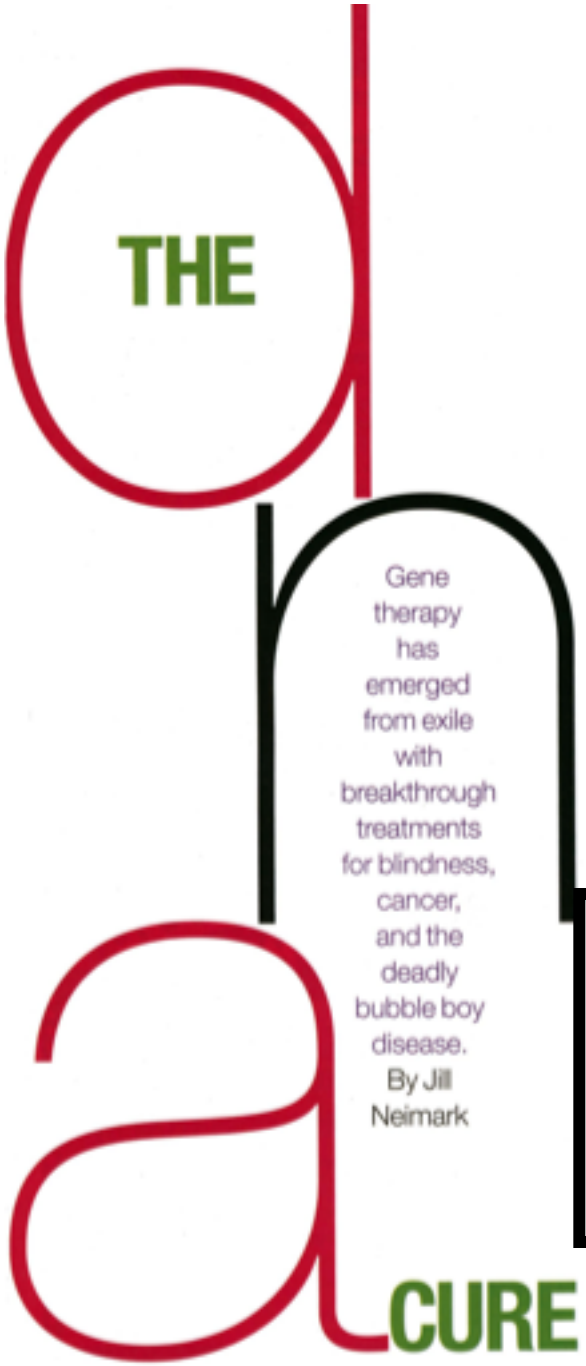
How About Genetically Engineered Humans?



Even Humans Have Been Genetically Engineered!!

Giving Sight by Therapy With Genes

By PAM BELLUCK
Published: November 2, 2009

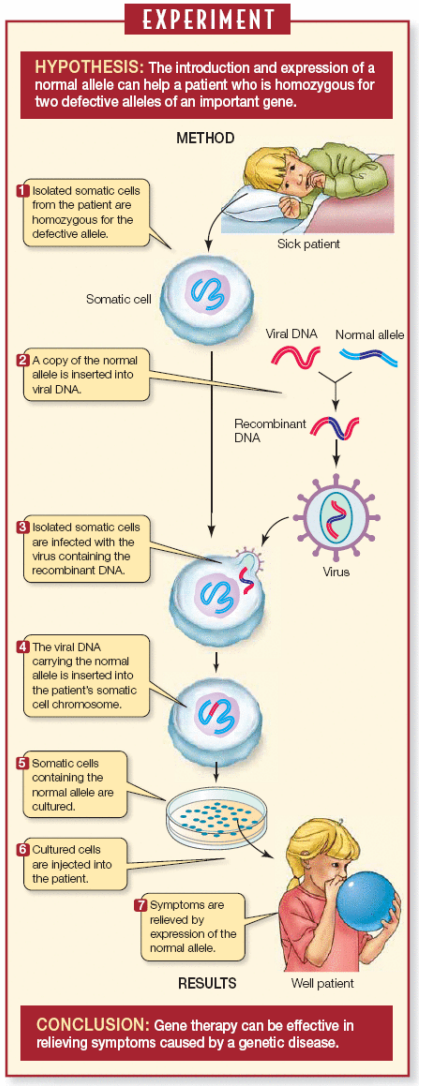
Gene therapy for red–green colour blindness in adult primates Nature, October, 2009

Gene Therapy Helps Blind Children See

By Jocelyn Kaiser
*Science*NOW Daily News
24 October 2009

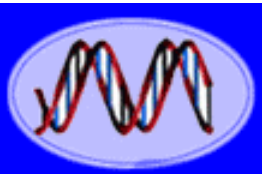
Humans Have Been Genetically Engineered To Cure a Lethal Genetic Disease (SCID)

The Age of Human Genetic Engineering Began Almost Twenty Years Ago Treating Severe Combined Immunodeficiency Disease (SCID) With Normal ADA Genes!!!



Several Teenagers Are Alive Because They Have Been Engineered With an ADA Gene That They Were Not Born With!!!

Adenosine Deaminase Gene (ADA)



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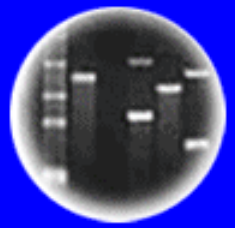

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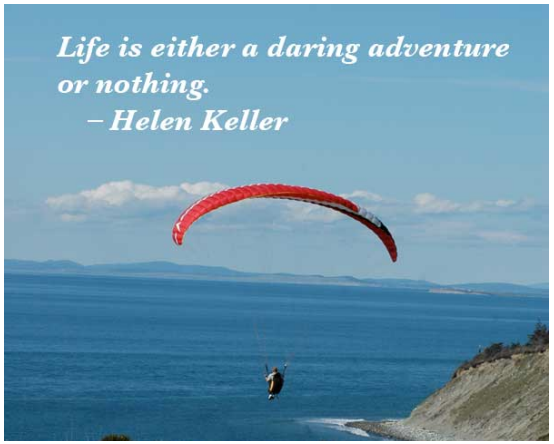
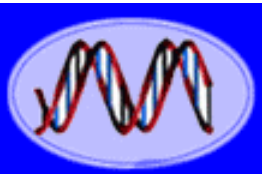
There Are NO Genetic Limitations to What Can Be Done Using Genetic Engineering

We Are Only Limited By Our Ingenuity and Our "Fear" of the Unknown





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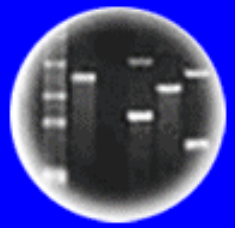

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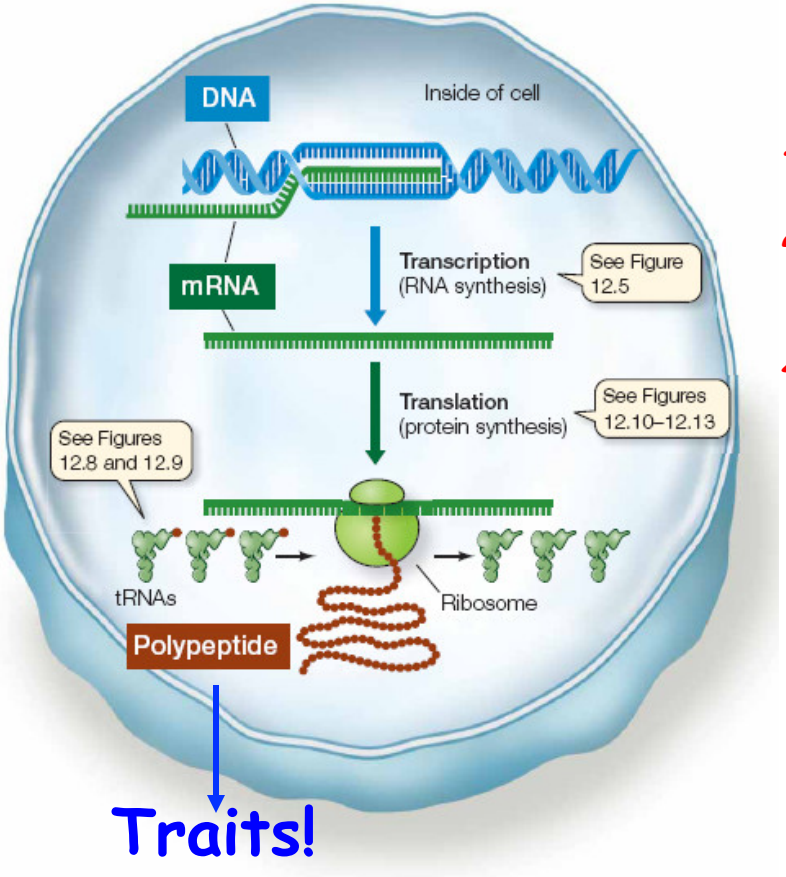
What Do These Genetic Engineering Experiments "Say" About the Unity of Genetic and Biological Processes?

What is the Hypothesis?

What are the Predictions?

What Experiment(s) to Test Predictions?

What Can We Infer FROM These Genetic Engineering Experiments About How Genes "Work" and Genetic Processes in All living Organisims?



1. *Genes Can Work Independently of Other*

2. *Basic Genetic Processes Are Universal (Replication & DNA to RNA to Protein)*

4. *Basic Genetic Processes Can Be Used to Engineer or Transfer Genes From One Organism to Another and Transfer Them Stably Generation After Generation*

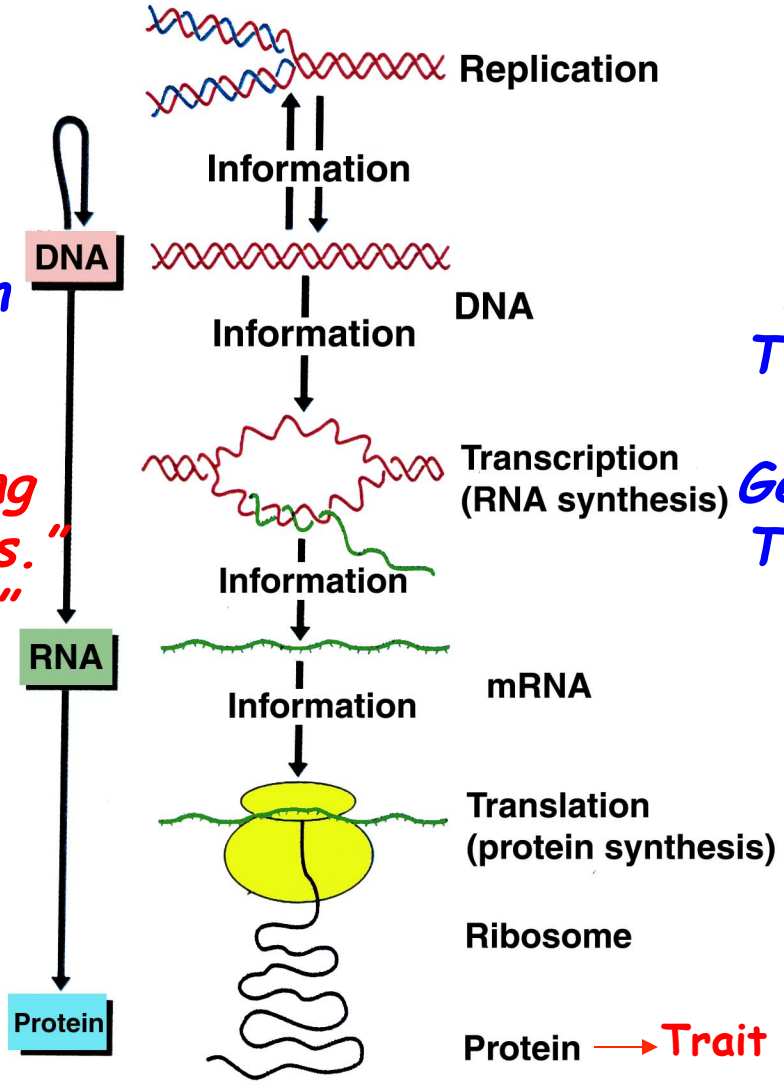
Observations and Inferences From the GloGene Experiments

1. *Genes Can Work Independently of Each Other - The Jellyfish Fluorescence Gene Works Perfectly in a Variety of Organisms*

2. *Basic Genetic Processes Are Universal (Replication & DNA to RNA to Protein) - The Jellyfish Gene Directs the Production of Fluorescence Protein That Glows in the Cells of a Variety of Organisms.*

5. *Basic Genetic Processes Can Be Used to Engineer or Transfer Genes From One Organism to Another and Transfer Them Stably Generation After Generation - The Jellyfish Gene Can Be Used To Engineer a Variety of Organisms That Glow and That Are Inherited Generation After Generation.*

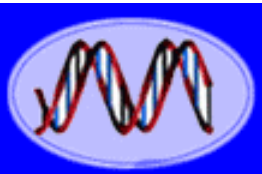
Translating The Genetic Code Into Proteins is a Conserved Process



Can Intervene in This Process in Cells

Genetic Engineering Is not "Hocus Pocus." It Uses "Natural" Cell Processes!!!!

All Organisms Use The SAME Processes And "RULES" to Generate Traits!! And The SAME Molecules & Chemistry!!



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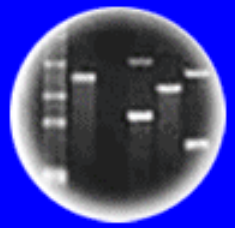

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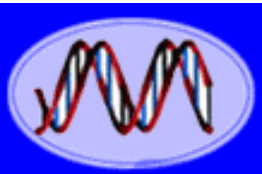
HOW IS SCIENCE CARRIED OUT?



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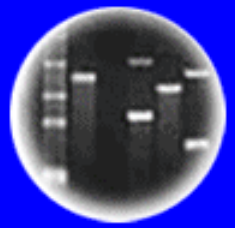

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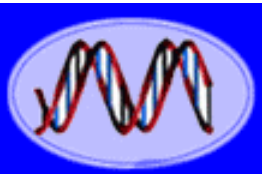
The Scientific Method

- What are the Observations?
- What is Your Hypothesis to Explain the Observations?
- What are the Predictions?
- How Test Hypothesis?
- What are the Experimental Data?
- Have the Data Been Verified & Peer Reviewed?



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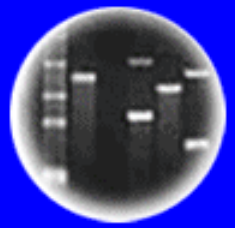

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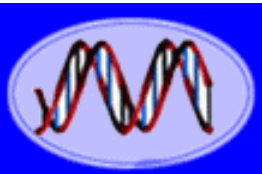
Science is NOT "Hocus Pocus" or Based on Opinions and Beliefs

- Science is Based on Observation, Hypothesis Testing, Rigorous Experimentation, and Verification

- Technology, or the Application of Scientific Knowledge, Has Transformed Dramatically Our Lives and How We Live

What Are the Data!!!!!



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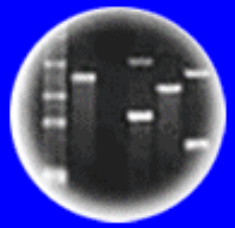

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It Has Lead to Civilization and Culture as We Know It!

- Agriculture
- Medicine
- Computers and Automation
- Airplanes, Cars, and Satellites
- Countries and Cities
- Political Systems
- Art and Literature
- Etc., Etc., Etc.

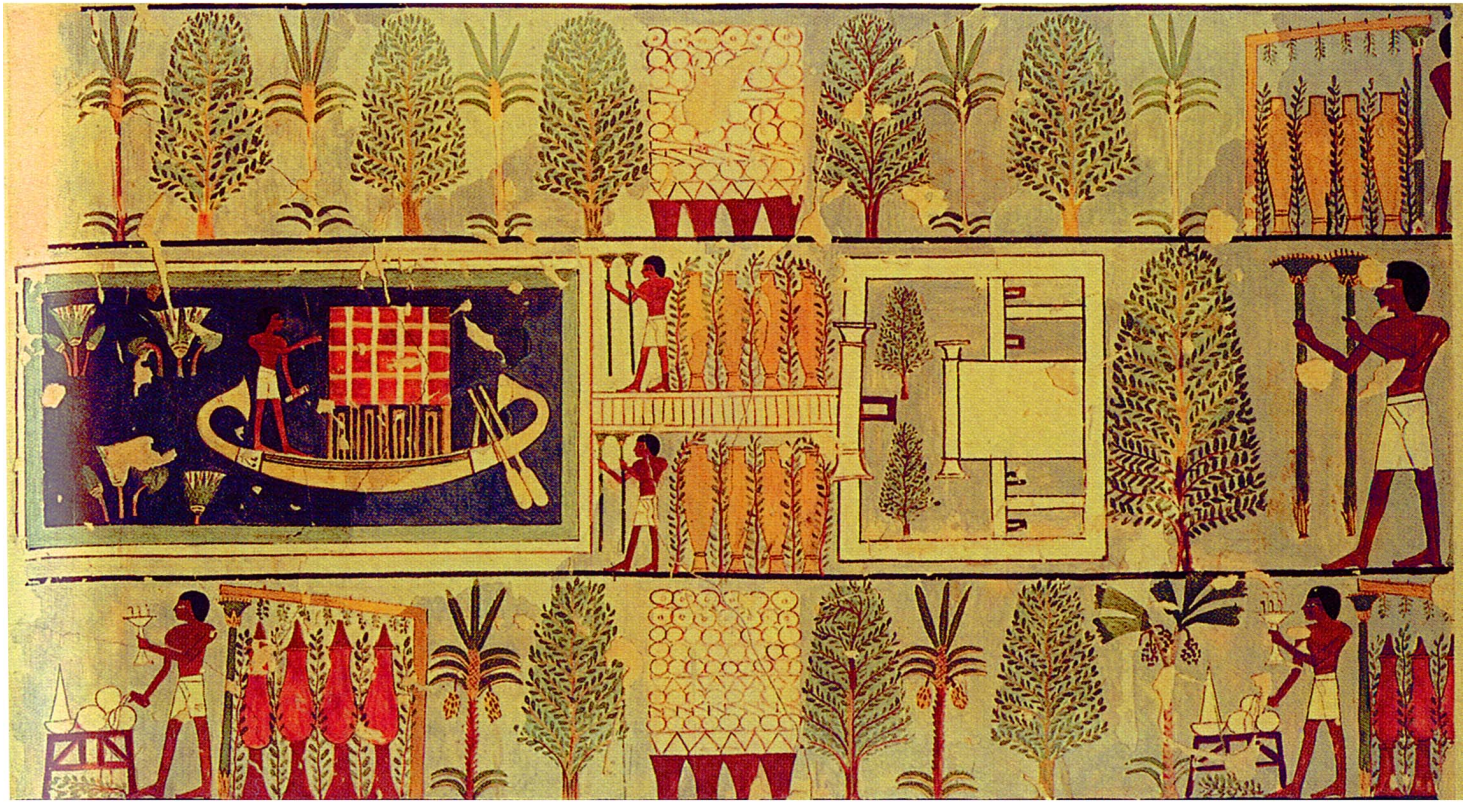
Simply Put:Our Way of Life!

Is Genetic Engineering a New Technology?

There is Nothing New About Genetic Engineering!

Manipulating Genes is Manipulating Genes No Matter What Technology or Processes Are Used!!

Breeding And Cultivation Of Plants Have Taken Place Over Thousand Of Years

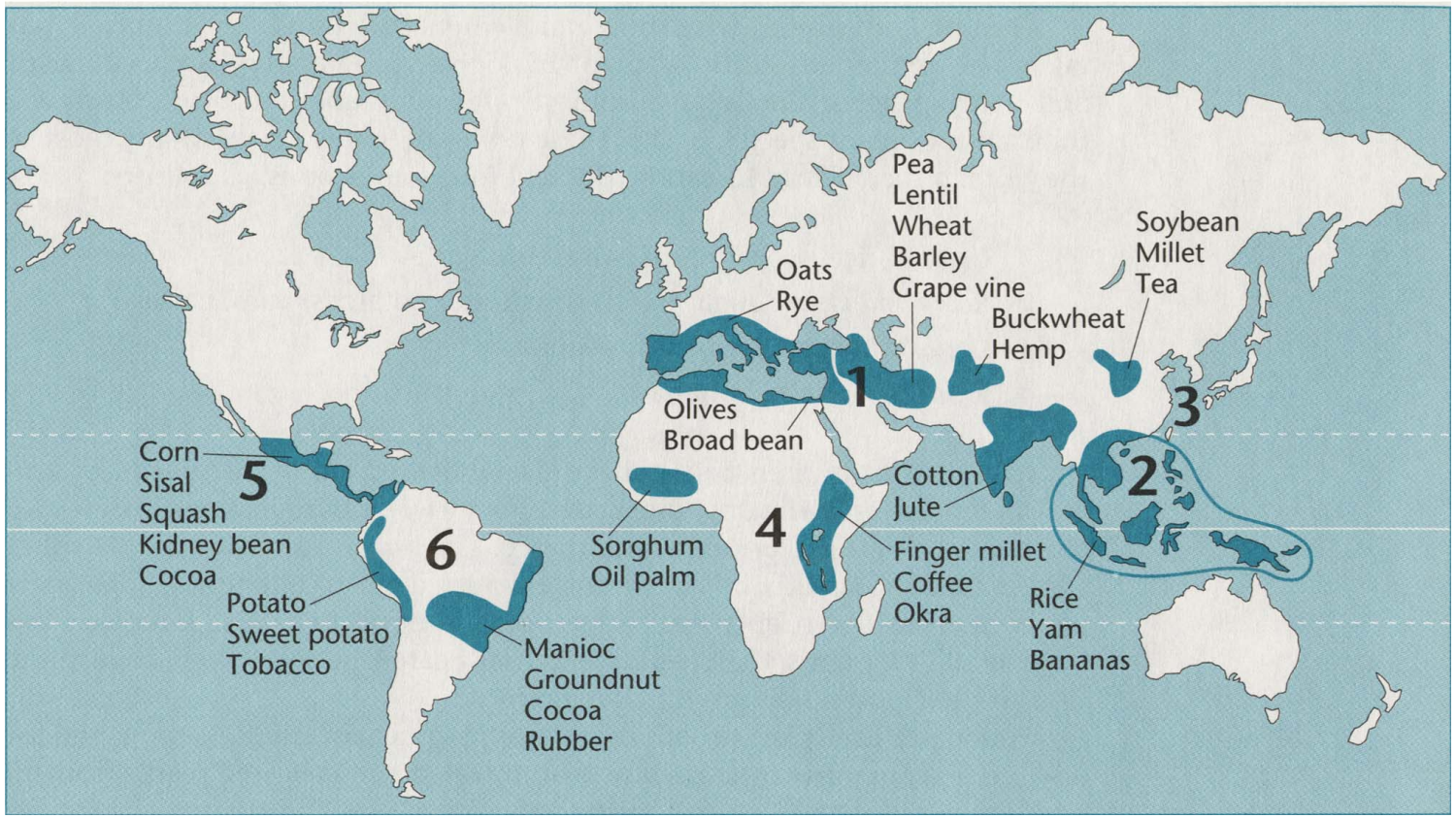


Genetic Engineering is Not New

Crops of Egypt 400 B.C.

Most Major Crops Were Engineered From Wild Relatives by Early "Bioengineers" Over 10,000 Years Ago!!

Regions Where Major Crops Were Established



Breeding Involves Gene Manipulation Using EXISTING Genetic Variability!

Breeding Uses Natural Genetic Variability of Genes As Raw Material - Variability Generated by Mutations

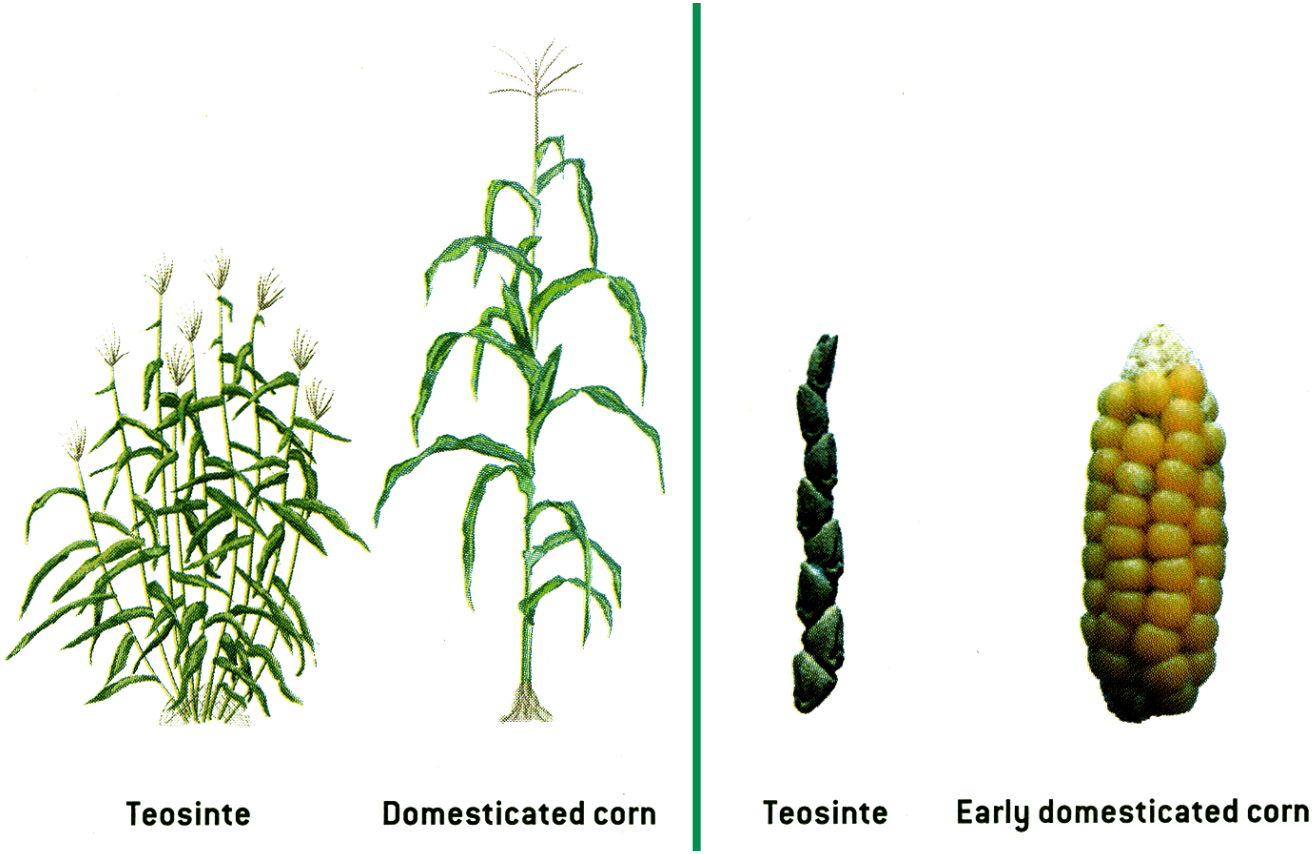
Mutations in a Gene That Change Its Chemical Sequence & Slightly Alters Its Function (e.g., fruit size, color)

Tomatoes Were Engineered From Small Wild Relatives Because of Mutations in Fruit Size Genes!

The Early Tomato "Bioengineers" Selected For Large Fruit Size Because it Provided More Food!

What They Were Selecting Was a Different Form (Allele) of a Fruit Size Gene!

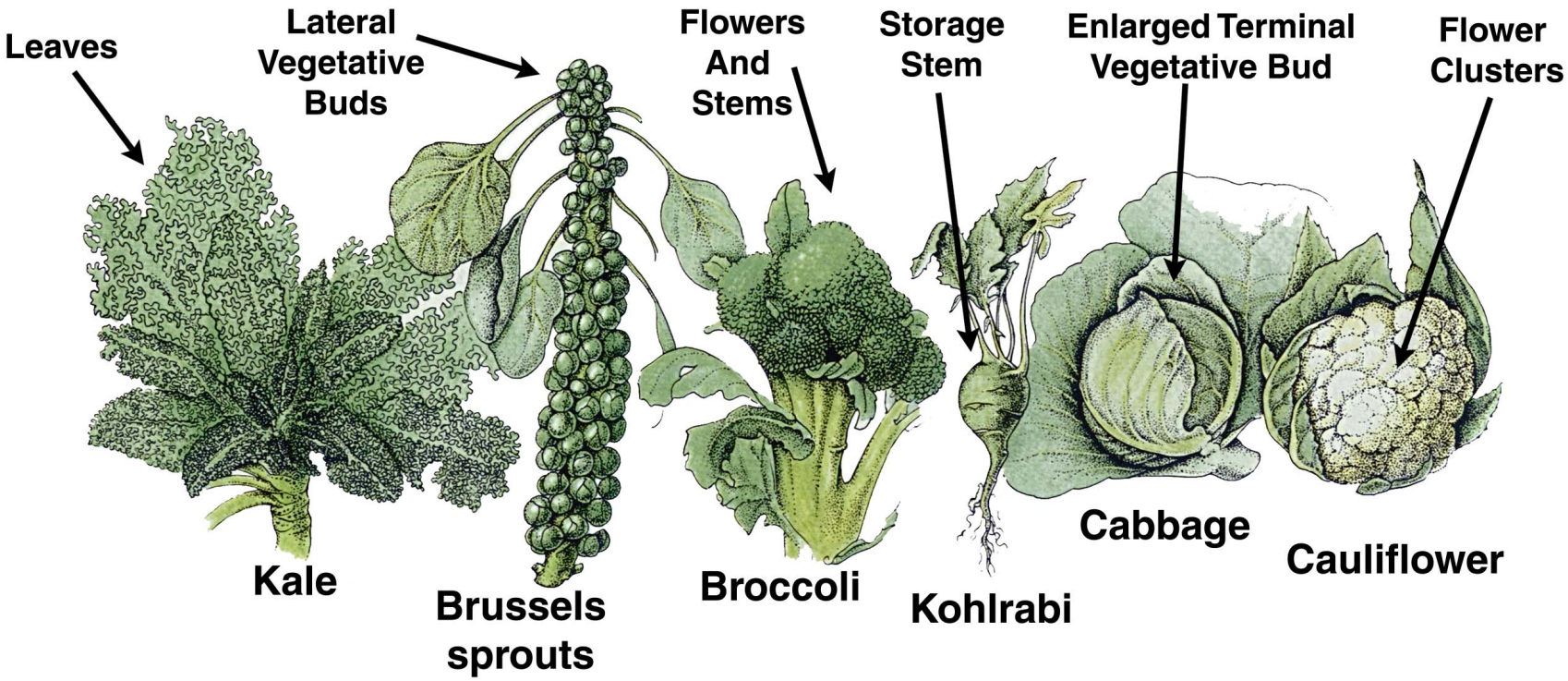
Engineering Teosinte Into Domesticated Corn



Note: Architecture and Fruit (cob) Size

Only Five Genes Cause These Plants to Differ & We Now Know What They Are

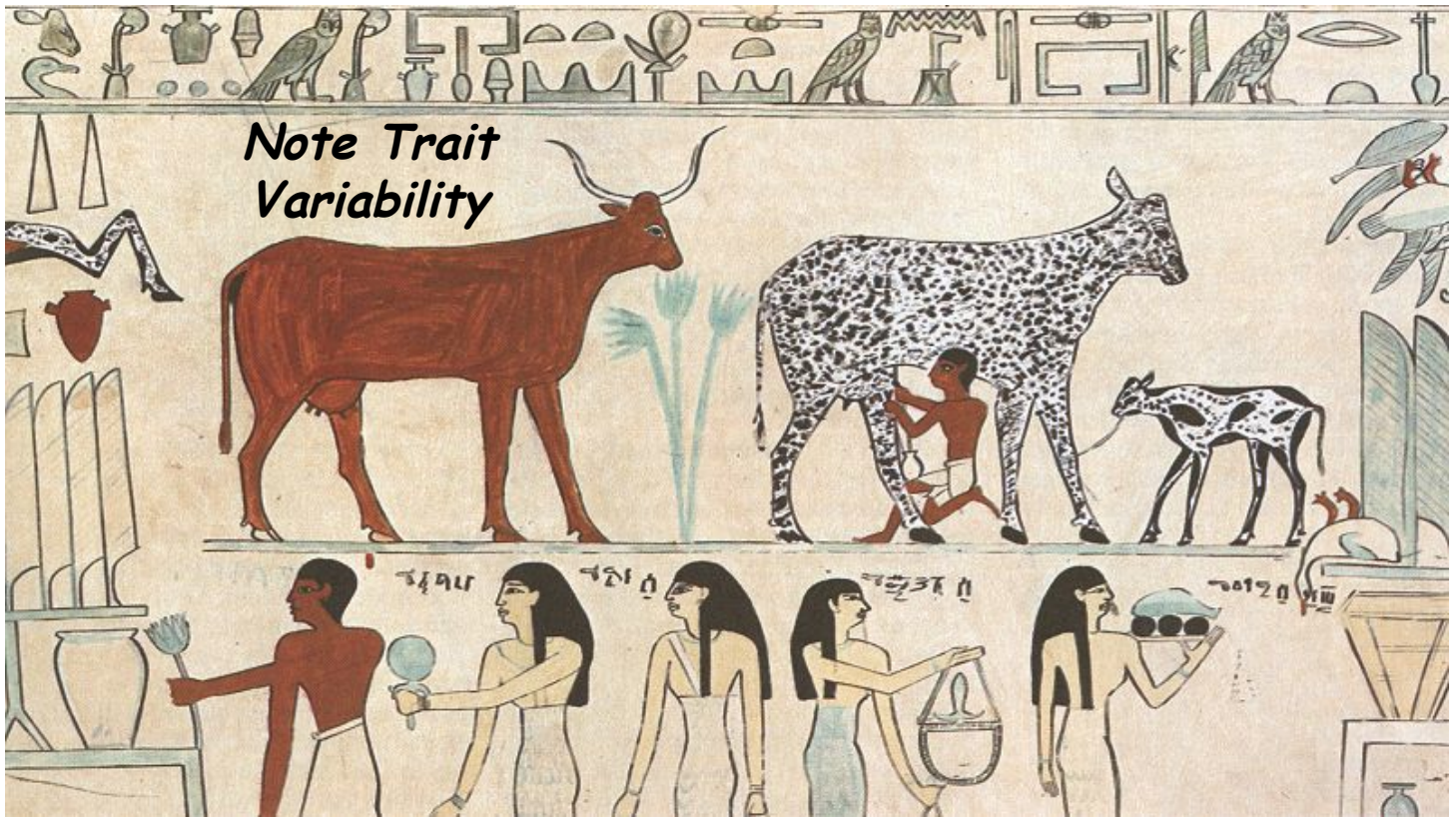
Breeders Have Selected For Variability In Plant Control Genes To Generate Novel Crops



How Are These Plants Related?

Engineered For Regulatory Genes!! Genes That Have Been Identified!!

Farm Animals Were Also "Engineered" By Breeding Wild Relatives
Cattle Breeding in Egypt 4,000 Years Ago!



Manipulating Existing Genetic Variability
Brought About By Chance Mutations!

Even Domesticated Pets Were "Engineered" By Breeding Wild Relatives

Vol 438|8 December 2005 nature

Nature, December 2005

NEWS & VIEWS

C. COLLINS/CORBIS

GENOMICS

The dog has its day

Hans Ellegren

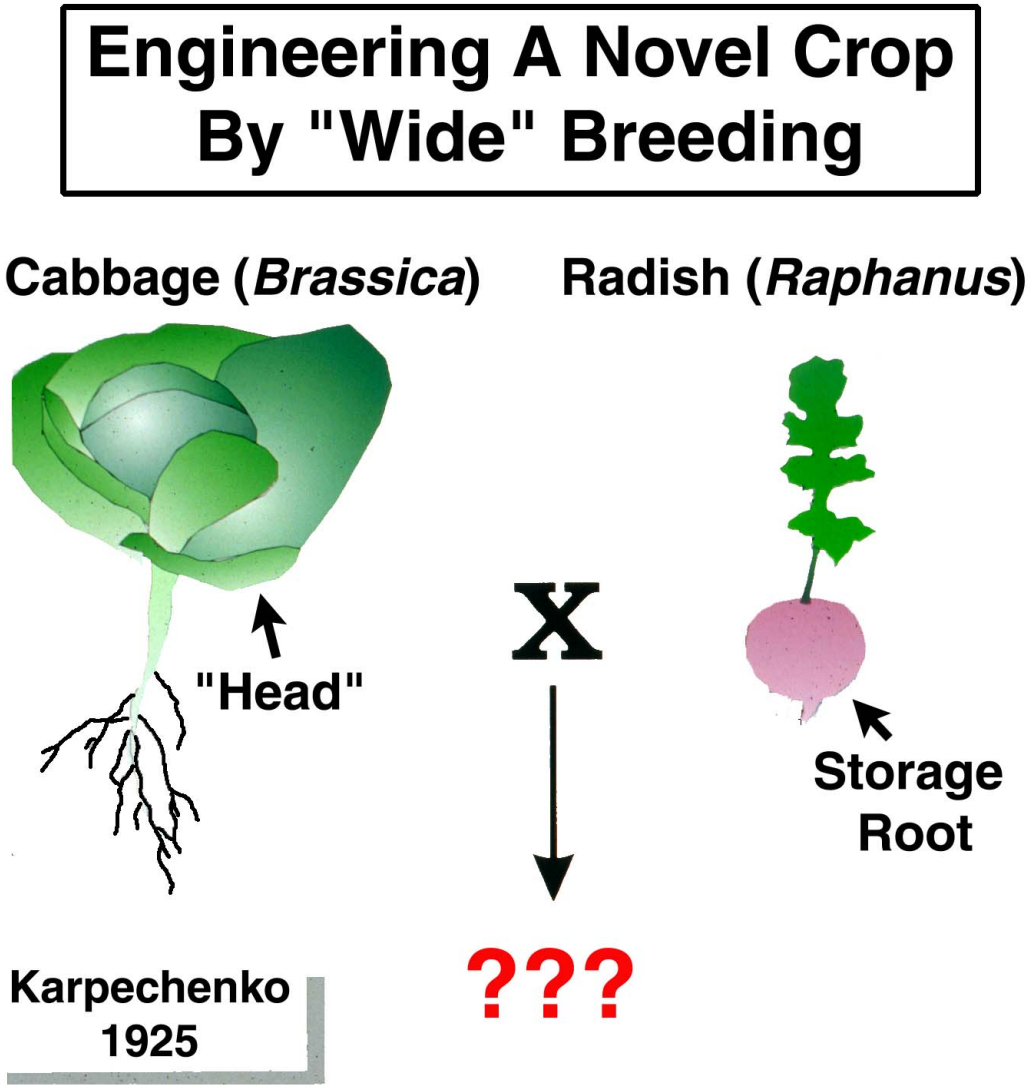
Domestication and selective breeding have transformed wolves into the diversity of dogs we see today. The sequence of the genome of one breed adds to our understanding of mammalian biology and genome evolution.

The Dog Genome Has Been Sequenced!

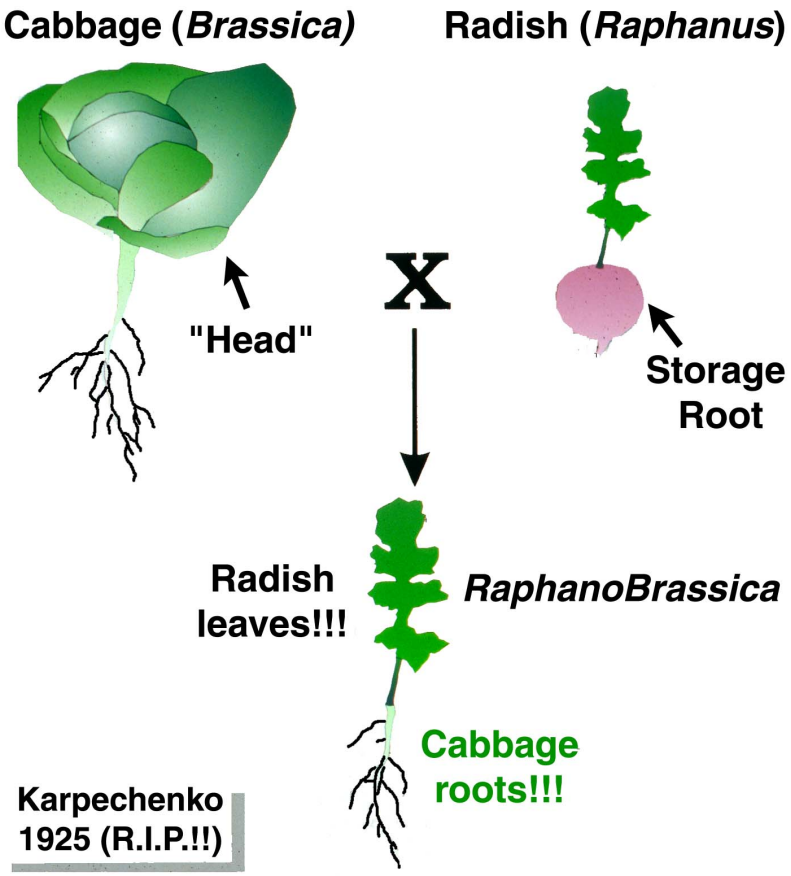
The Problem With Breeding the "Old Fashioned Way"

Cannot Predict Results!

The Problem With Breeding the "Old Fashioned Way"



Engineering A Novel Crop By "Wide" Breeding



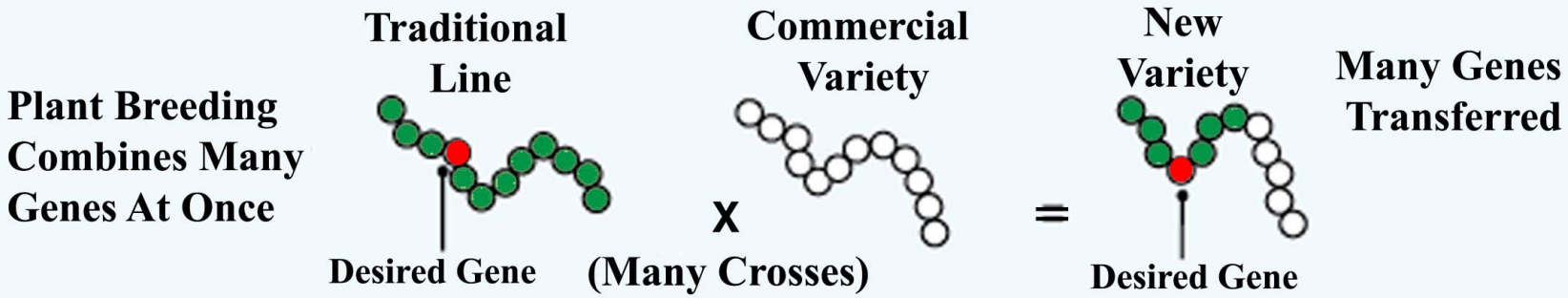
Results Show the Unpredictability of Classical Breeding Approaches
Compare With the Modern Genetic Engineering Examples Shown Previously

Genetic Engineering is a Technique!

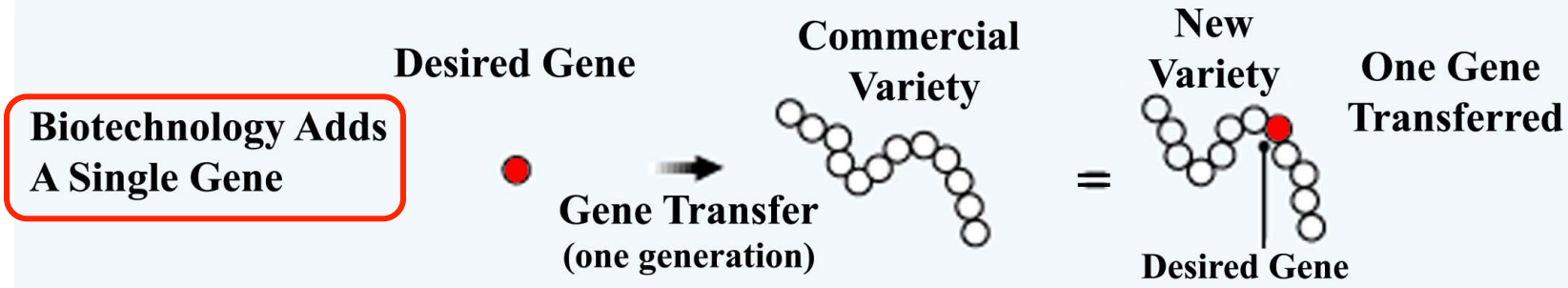
How Do Classical Genetic Engineering Methods Differ From Those Using DNA and 21st Century Technologies?

Classical vs. Molecular Genetic Engineering

TRADITIONAL PLANT BREEDING



PLANT BIOTECHNOLOGY



What Are The Limitations of Classical Breeding/Genetic Engineering?

1. Limited To Genes of Interbreeding Organisms and Severe Ethical Issues With Humans
2. Only Can Make New Combinations of EXISTING Genes - Genes Created By "Natural" Mutations
3. Can't Make Existing Genes "Better" - Just Better or More Useful Combinations of Existing Genes and/or Alleles
4. Takes Time - Limited To Generation Time of Organism - Decades For Some Crop Plants
5. Only Useful For "Obvious" Traits - One's That Can Be Observed or Followed

What Are The Advantages of Using 21st Century Genetic Engineering Methods?

1. Any Gene From Any Organism Can Be Used In Any Organism - There Are No Breeding Barriers (e.g., genes of all sequenced genomes)

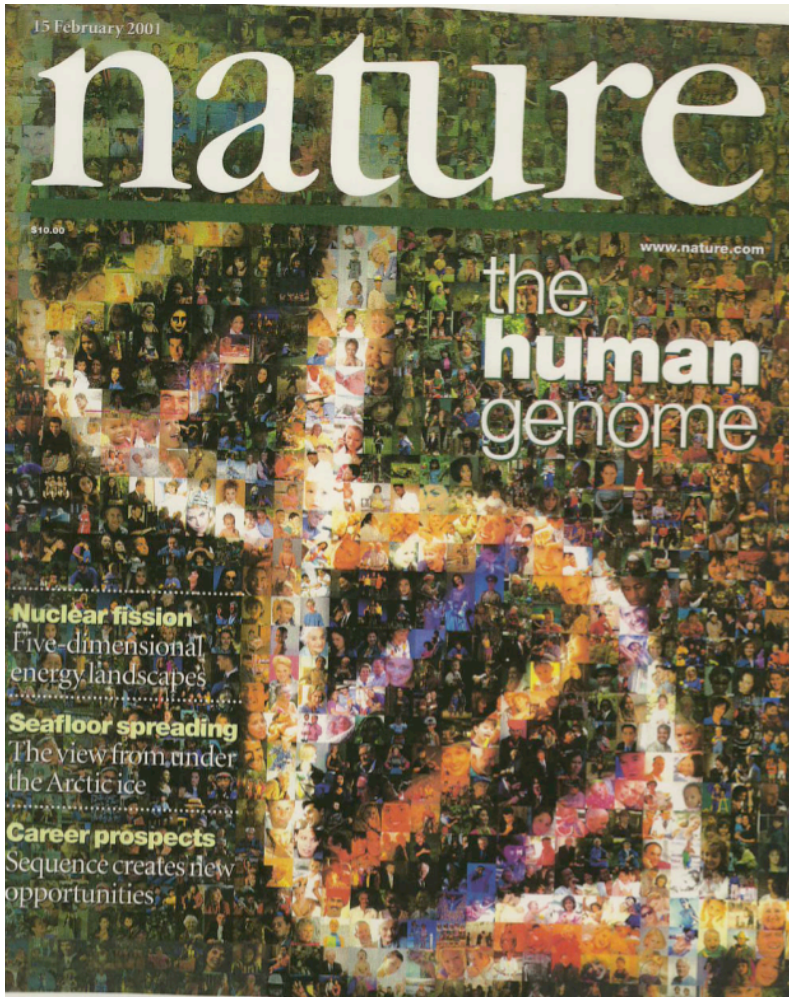
2. New Genes Can Be Engineered - Genes That Work Better and/or Produce New Proteins (i.e., create new genetic variability and/or alleles)

3. Existing Genes Can Be Engineered to be Switched On in "Places" That They Are Normally Off - Gene Control or Regulation Altered (e.g., fly eye on leg)

4. Speed - Can Engineer a New Organism in a Generation

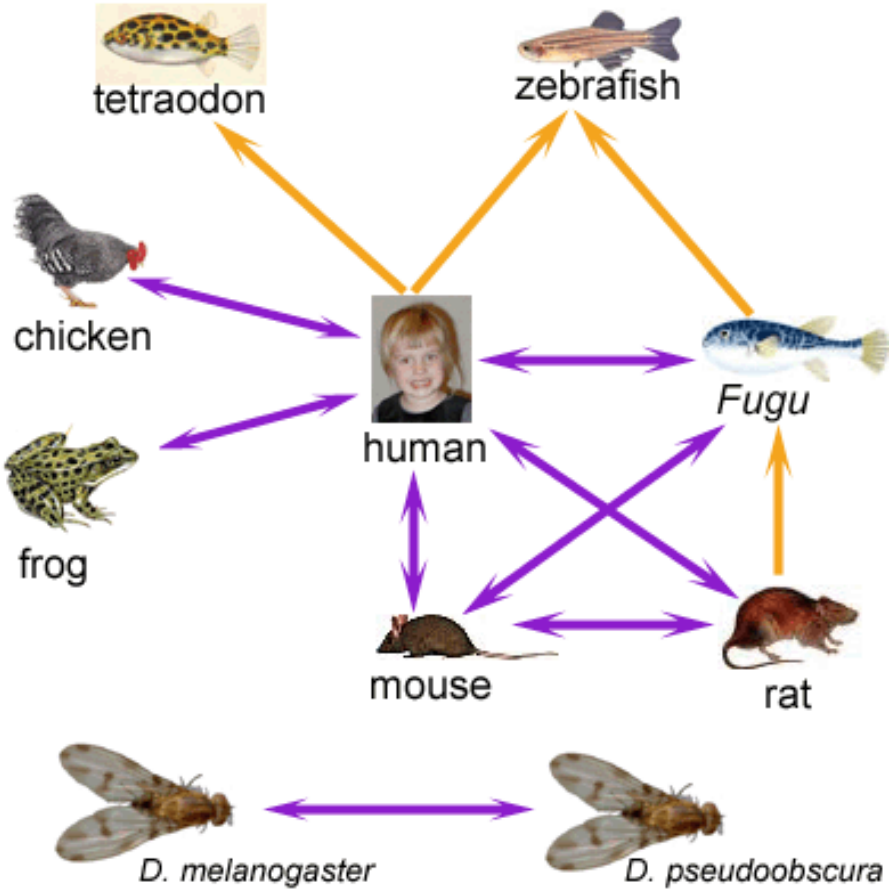
5. Can Change, Alter, Manipulate, Synthesize and/or Control the Genetic Blueprint of Any Organism

The Era of 21st Century Genomics Will Enable Us To Have Access to ALL Genes of Every Organism of the Earth

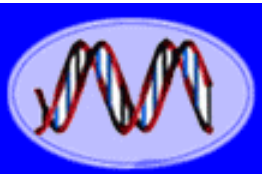


The Genomes of Many Organisms Have Been Sequenced Providing New Knowledge About Our Origins and Cellular Functions

The Future is Unlimited!

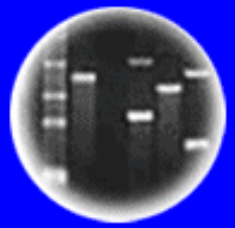


Providing Thousands of New Genes and Proteins To Be Engineered For Practical Applications (e.g., cellulases in termite gut bacteria for biofuel production)



DNA
Genetic Code of Life

Entire Genetic Code
of a Bacteria



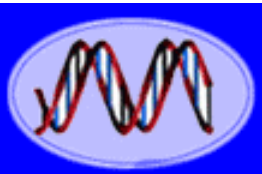
DNA Fingerprinting

Cloning: Ethical Issues
and Future Consequences

Plants of Tomorrow

HC70A Winter 2011
Genetic Engineering in Medicine, Agriculture, and Law
Professor Bob Goldberg

Class Announcements
1/4/11



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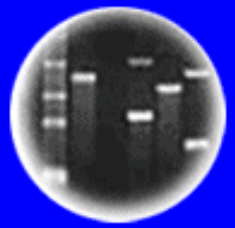

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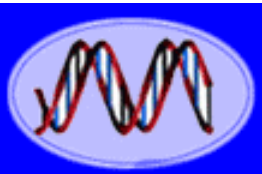
HC70A Winter 2011 (UCLA)
Genetic Engineering in Medicine, Agriculture, and Law

Teaching Fellows

Elaine Chiu
Eden Maloney
Lulu Pantain

Course Administrators

Ann Amores
Jennifer Kwan



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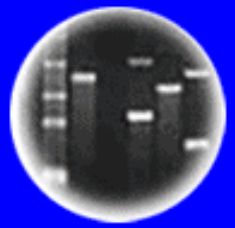

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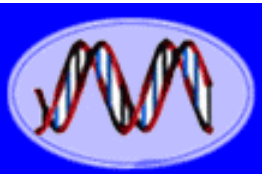
SAS70A Winter 2011 (UC Davis) Genetic Engineering in Medicine, Agriculture, and Law

UC Davis

Professor John Harada

TA - Ryan Kirkbride

UCDAVIS
UNIVERSITY OF CALIFORNIA



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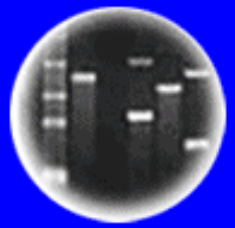

DNA Fingerprinting

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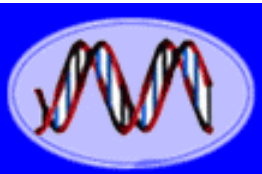
Plants of Tomorrow

Discussion Tomorrow

- Recombinant DNA Debate
- *The Manipulation of Genes*
- Berg Biohazard Letter

- Read Papers Handed Out Today & Textbook Chapters 1-3

- Be Prepared for a Discussion of the History & Science of Genetic Engineering Providing the Foundation



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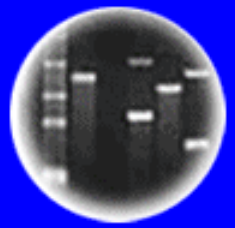

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Plants of Tomorrow

Discussion

- Come PREPARED!!!!!
- Read Articles Carefully Prior to Discussion
- What's the Question, the Approach, the Results, the Conclusions?
- Study Each Figure/Experiment/Legends-Ask The Same Questions!
- Read Relevant Parts of Text That Relate to Concepts Covered in Articles
- Read Articles ACTIVELY -Look Up Unknown Words/Concepts - Ask Yourself Questions Along the Way - What Does This Mean?!