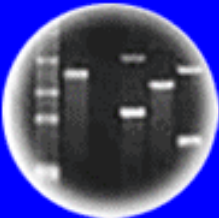


DNA
Genetic Code of Life



Entire Genetic Code
of a Bacteria



DNA Fingerprinting



Cloning: Ethical Issues
and Future Consequences



Plants of Tomorrow

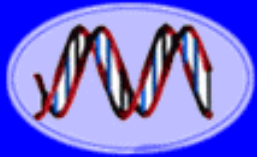
HC70A & SAS70A Winter 2010 Genetic Engineering in Medicine, Agriculture, and Law

Professors Bob Goldberg & John Harada

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

UCLA

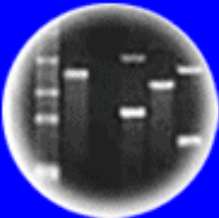
UCDAVIS
UNIVERSITY OF CALIFORNIA



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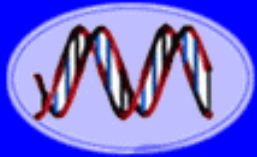
Cloning: Ethical Issues
and Future Consequences



Plants of Tomorrow

THEMES

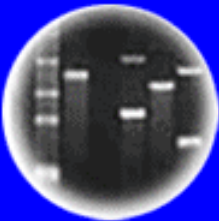
1. The Age of DNA, Genomics, Genetic Engineering & Mammalian Reproduction
2. What Do Genes Look Like - DNA Demonstration
3. DNA Into Your Home
4. How Was Modern Genetic Engineering “Invented?”
5. What Is Genetic Engineering & How Has It Affected Our Lives?
6. What Can Be Done With Genetic Engineering?
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 and Genetic Engineering - Impact on Humankind?



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Plants of Tomorrow

Going Long Distance

HC70A & SAS70A Winter 2010




UC DAVIS
UNIVERSITY OF CALIFORNIA



UCLA

A Model For Cross-Campus Interactive Learning

Winter 2010-UCLA and UCDavis Students Learning Genetic Engineering in One Interactive Classroom!!



MyUcla

Features WebMail Quicklinks Help Logout


CLASS LIST FOR WINTER 2009

Winter 2009


weekly grid schedule of classes

All Winter 2009 Classes

GEN ENGR-MED&AG&LAW	222-236-200
HNRS 70A - LEC 1 Bob Goldberg	Enrolled: 0
TR 3:30 PM-5:50 PM	LAKRETZ 120
Email Roster Gradebook PTE Turnitin	



This window was opened by MyUCDavis. Click on the tab to return to MyUCDavis.



COURSE WEBSITE

[MyUCDavis Login](#)
[Contact Us](#) · [Search](#)

[SAS 070A Sec: 001](#) >> [Assignments](#) | [Grades](#) | [Quizzes](#) | [Glossary](#) | [Mailing List](#) | [Newsgroup](#) | [Disc. Board](#) | [Chat Room](#)

You are an instructor/proxy viewing the website as yourself. [Change View](#)

Genetic Engin Med Ag Law

Subject Area: Science and Society [Help](#)

CRN: 54390

Instructor: John Harada

Announcements

Your instructor has not posted any announcements.

Meeting Times:
TR 1530-1800

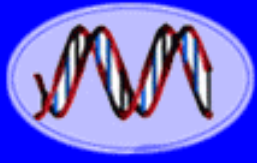
Location:
OLSON 250

[View final grade](#)

Description: (see course catalog or schedule of classes for most current)
No Course Description Found. Refer to the UCD course catalog for course information.

UCDAVIS
UNIVERSITY OF CALIFORNIA

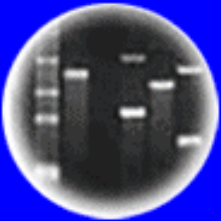




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Plants of Tomorrow

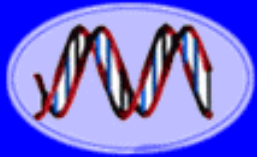
HC70A Winter 2010 (UCLA) Genetic Engineering in Medicine, Agriculture, and Law

TAs

Daisy Robinton
Jordan Fischer
Kristen Gill

Course Administrator

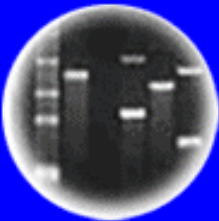
Jennifer Gottesfeld



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Cloning: Ethical Issues
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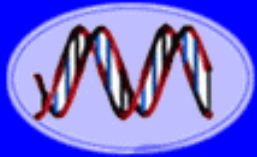
Plants of Tomorrow

SAS70A Winter 2010 (UC Davis) Genetic Engineering in Medicine, Agriculture, and Law

UC Davis

Dr. John Harada
TA - Ryan Kirkbride

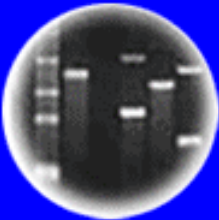
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UNIVERSITY OF CALIFORNIA



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Plants of Tomorrow

Today - We Live in the Era of....

- Genes & DNA
 - Genetic Engineering of Microbes, Plants, & Animals
 - Biotechnology Using Genetic Engineering Technology
 - Genomics & Genome Sequencing
 - Personalized Genomes and Ability to Identify Any Individual Using DNA
 - Mammalian Reproduction, Stem Cells & Cloning
- And the SYNTHESIS of These Technologies!!

Nature, November 2008

LETTERS

Sequencing the nuclear genome of the extinct woolly mammoth

Webb Miller¹, Daniela I. Drautz¹, Aakrosh Ratan¹, Barbara Pusey¹, Ji Qi¹, Arthur M. Lesk¹, Lynn P. Tomsho¹, Michael D. Packard¹, Fangqing Zhao¹, Andrei Sher^{2,†}, Alexei Tikhonov³, Brian Raney⁴, Nick Patterson⁵, Kerstin Lindblad-Toh⁵, Eric S. Lander⁵, James R. Knight⁶, Gerard P. Irzyk⁶, Karin M. Fredrikson⁷, Timothy T. Harkins⁷, Sharon Sheridan⁷, Tom Pringle⁸ & Stephan C. Schuster¹

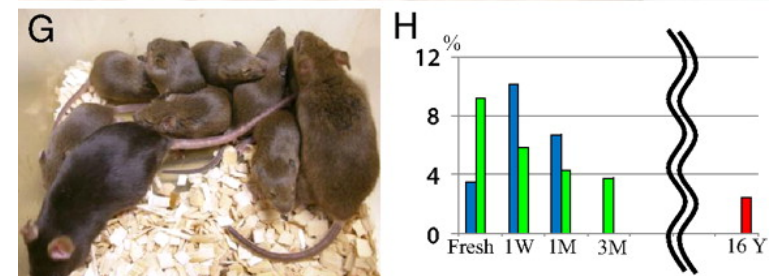
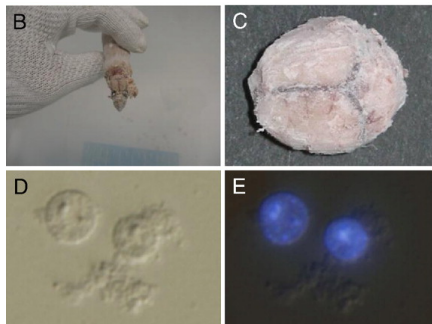


**Fossil Hair For DNA
200,000 Years Old**

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

Sayaka Wakayama^a, Hiroshi Ohta^a, Takafusa Hikichi^a, Elji Mizutani^a, Takamasa Iwaki^b, Osami Kanagawa^c, and Teruhiko Wakayama^{a,1}

^aRIKEN, Center for Developmental Biology, 2-2-3 Minatojima-minamimachi, Kobe, 650-0047, Japan; ^bJikei University School of medicine, Tokyo 105-8461, Japan; and ^cRIKEN, Research Center for Allergy and Immunology, 1-7-22, Sushiro-cho, Tsurumi-ku, Yokohama, 230-0045, Japan



ARTICLES

Nature, November, 2006

Analysis of one million base pairs of Neanderthal DNA

From a 45,000 Year-Old Bone

Richard E. Green¹, Johannes Krause¹, Susan E. Ptak¹, Adrian W. Briggs¹, Michael T. Ronan², Jan F. Simons², Lei Du², Michael Egholm², Jonathan M. Rothberg², Maja Paunovic^{3†} & Svante Pääbo¹



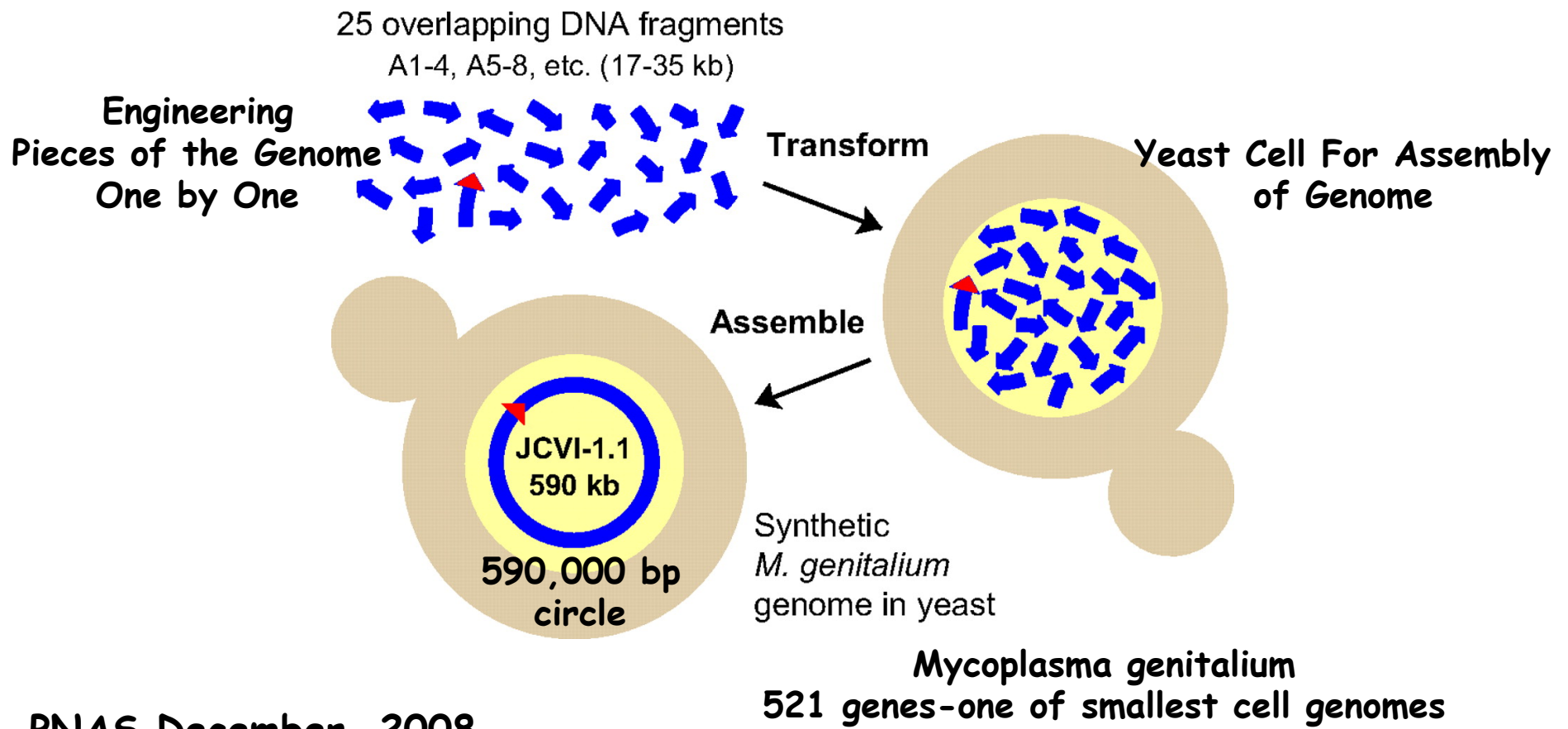
What About
the Future?



January 24, 2008

Scientists Take New Step Toward Man-Made Life

By [ANDREW POLLACK](#)



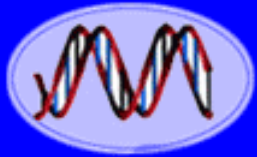
PNAS December, 2008

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 35 Years From Experiments in Biology Laboratories Around the Globe

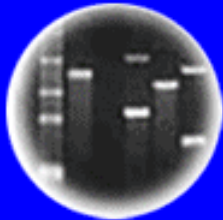
- Has Changed Our Lives Dramatically!



DNA
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Entire Genetic Code
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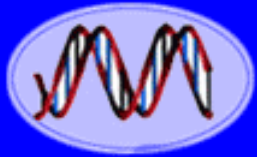
DNA Fingerprinting



Cloning: Ethical Issues
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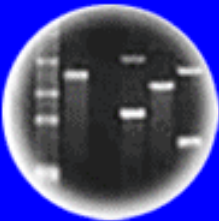
Plants of Tomorrow



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Plants of Tomorrow

- From New Medicines

- To Better Crops

- To the Sequence of the Human Genome

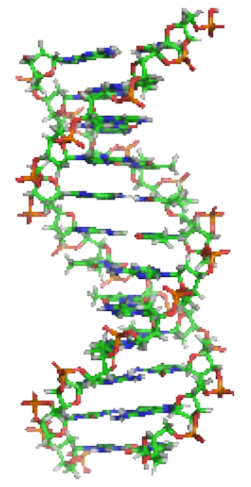
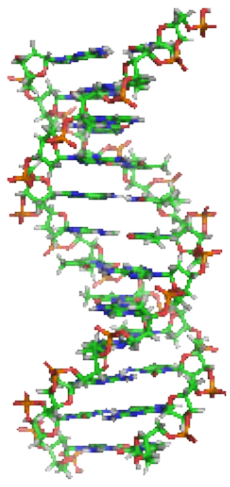
- To Understanding the Basis of Human Disease and Aging

- To Novel Ways To Identify Individuals

- To Personalized Genomes and Medicine

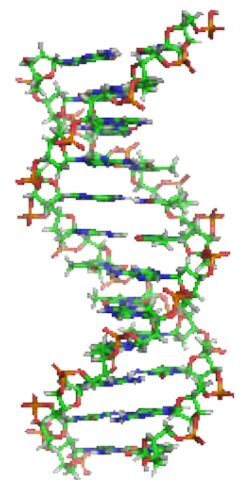
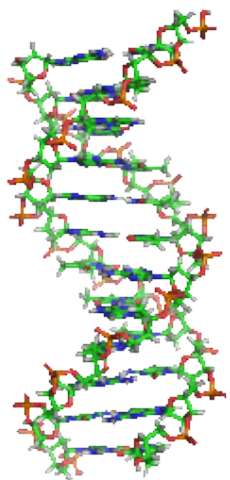
- To the Ability to Eventually Unravel the Mysteries of ALL Cellular Processes!

- To Ultimately -- Immortality?



The Age of DNA!

Genetic Engineering Is
Manipulating DNA!



DNA is Part of Our Culture!!



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



MedicalLegalTesting.com
Accurate DNA Identification Tests To Meet
Requirements Of The Civil Court System
(800) 456-9913

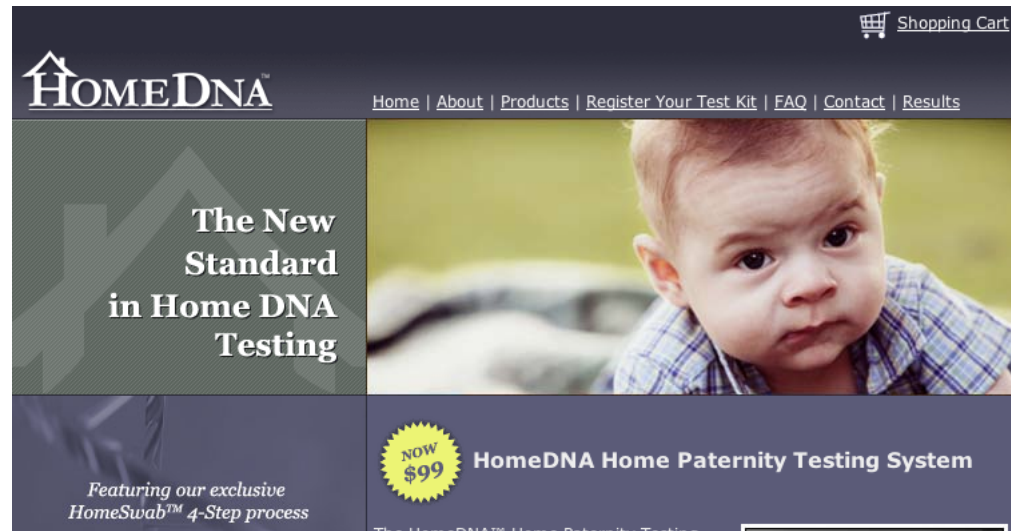
The banner features a close-up of a baby's face on the left and three young children on the right.



DNA Tribes
Genetic Ancestry Analysis
What's Your Tribe?
Discover your connections to over 695 world populations in 4 easy steps:

The banner includes a satellite map of the world and two circular portraits of people from different ethnicities.

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



HomeDNA
Home | About | Products | Register Your Test Kit | FAQ | Contact | Results
Shopping Cart

The New Standard in Home DNA Testing

Featuring our exclusive HomeSwab™ 4-Step process

NOW \$99 HomeDNA Home Paternity Testing System

The HomeDNA™ Home Paternity Testing System

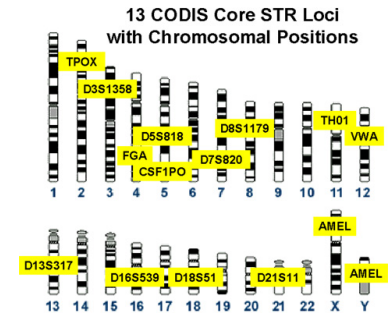
The screenshot shows the HomeDNA website with a navigation bar, a main headline, and a promotional offer for a paternity testing kit.

DNA Testing for Immigration

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



NDIS Statistics

| [CODIS Home Page](#) | [FBI Home Page](#) |

As of October 2007 the profile composition of the National DNA Index System (NDIS) is as follows:

Total number of profiles: 5,265,258

Total Forensic profiles: 194,785

Total Convicted Offender profiles: 5,070,473

This IS the Age of DNA!

DNA links suspect to piggy bank robbery

January 5, 2008 SHEBOYGAN, Wis. -- A man has been charged with sneaking into a toddler's bedroom and stealing \$20 from a piggy bank while the 2-year-old girl slept. Authorities say DNA evidence linked Ryan Mueller, 30, of Sheboygan Falls, to the crime Aug. 10 in Wilson. Mueller was charged with felony burglary, which carries a penalty of up to 9 years. Bond was set at \$10,000.

AP

Set Free By DNA Evidence

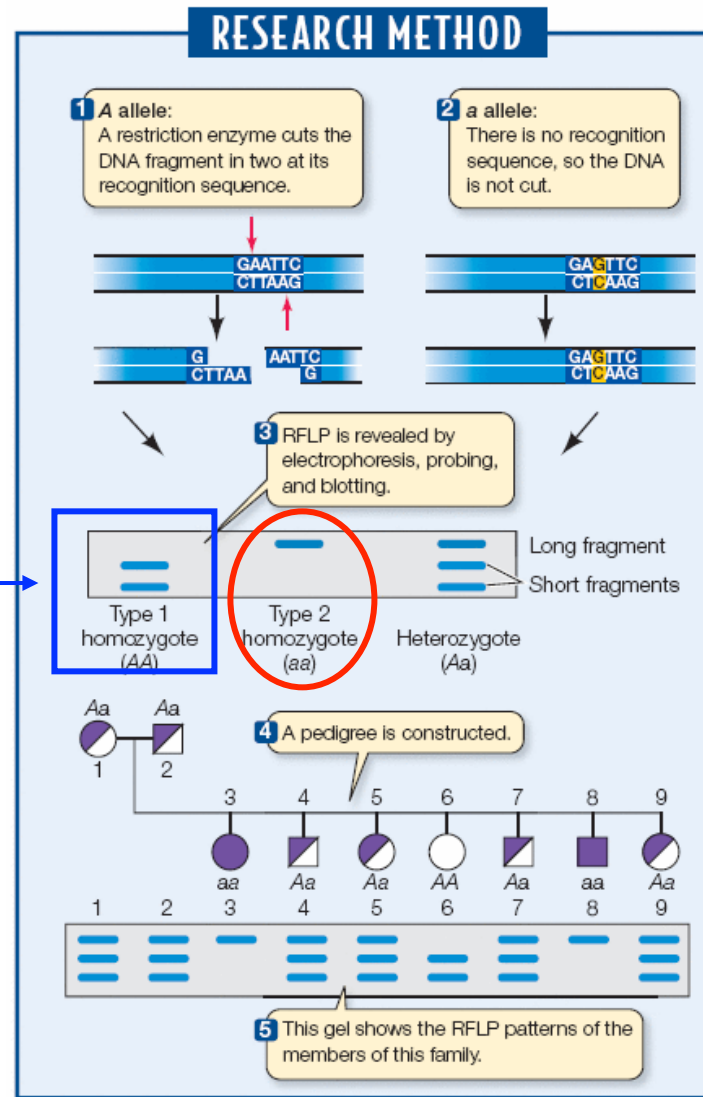


15th Person Cleared by DNA in Dallas. Charles Chatman was released from state custody Jan. 3 in Dallas, after serving nearly 27 years in prison for a rape he didn't commit. He is the 15th Dallas man to be cleared by DNA testing after being wrongfully convicted. After his hearing, he hugged Judge John 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.

Using DNA Fingerprints to Identify Individuals & Genes

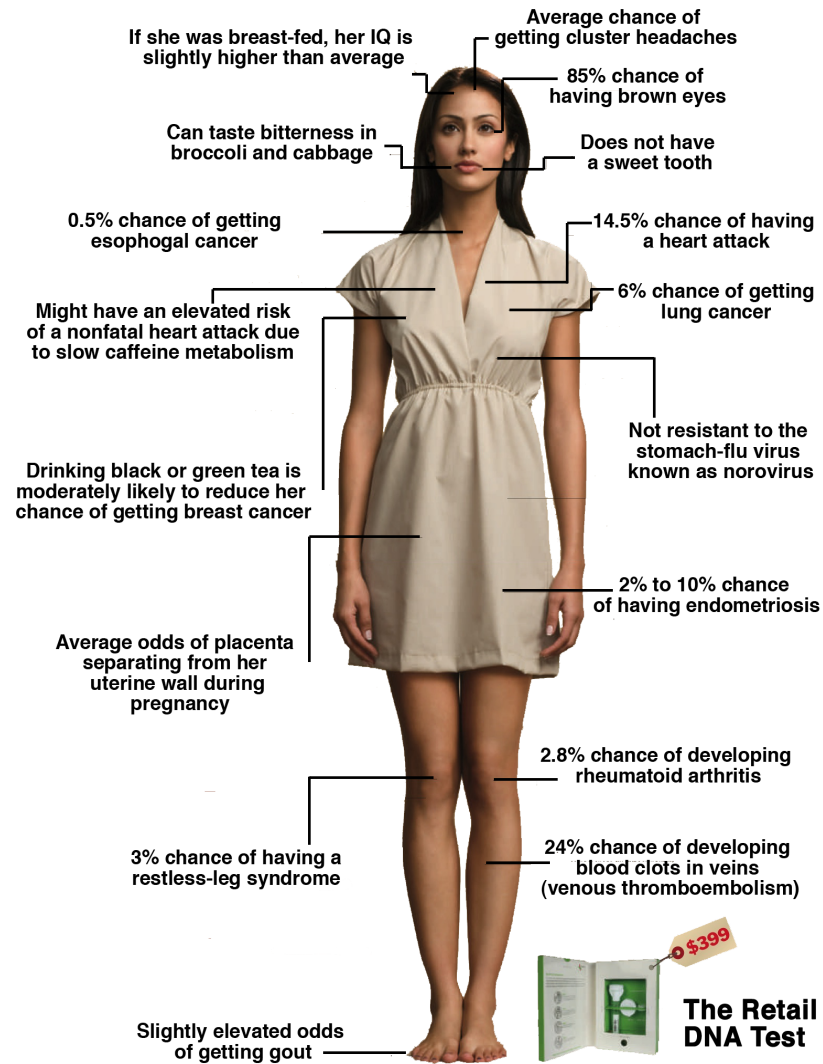
DNA Fingerprints →



*What is YOUR DNA
Fingerprint?*

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

What Your Gene Test Can Tell You



**And
Before Birth!!!**

<https://www.23andme.com/>

Invention Of the Year

We Live in an Era Where the Genome of Specific Individuals Can Be Decoded and Sequenced!

Genome of DNA Pioneer Is Deciphered

By NICHOLAS WADE
Published: May 31, 2007

James Watson's Personal Genome Sequence



README: [How do I use the James Watson Genome Browser?](#)

Downloads: Download bulk JW polymorphisms. For the complete data set, please go to the [NCBI Trace Archive](#) and search for `CENTER_NAME = 'CSHL'` and `CENTER_PROJECT = 'Project Jim'`.

Showing 34.46 kbp from chr7, positions 75,221,807 to 75,256,264

☐ Instructions

Search using a sequence name, gene name, locus, or other landmark. The wildcard character * is allowed. To center on a location, click the ruler. Use the Scroll/Zoom buttons to change magnification and position.

Examples: [HTR2A](#), [macular degeneration](#), [rs726455](#), [DAOA](#), [chr22:20230140..20330139](#), [PARK3](#), [SNP:rs131693](#), [SPTB](#), [NM_001008496](#), [3q21.2](#), [ENM010](#).

[\[Hide banner\]](#) [\[Bookmark this\]](#) [\[Link to Image\]](#) [\[High-res Image\]](#) [\[Help\]](#) [\[Reset\]](#)

☐ Search

Landmark or Region:

chr7:75221807..75256264 Search

Reports & Analysis:

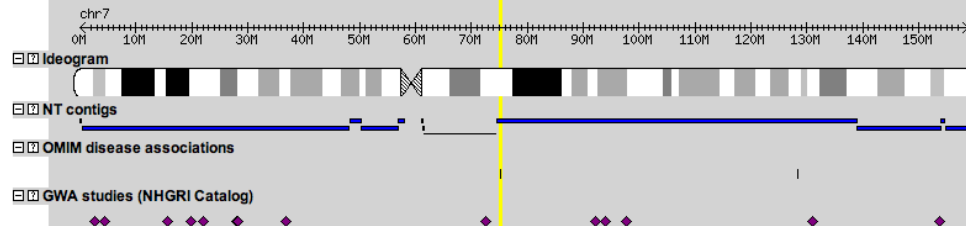
Download Decorated FASTA File Configure... Go

Data Source

James Watson genotypes, on NCBI B36 assembly, dbSNP b126

Scroll/Zoom: << < > >> Show 34.46 kbp + >>> Flip

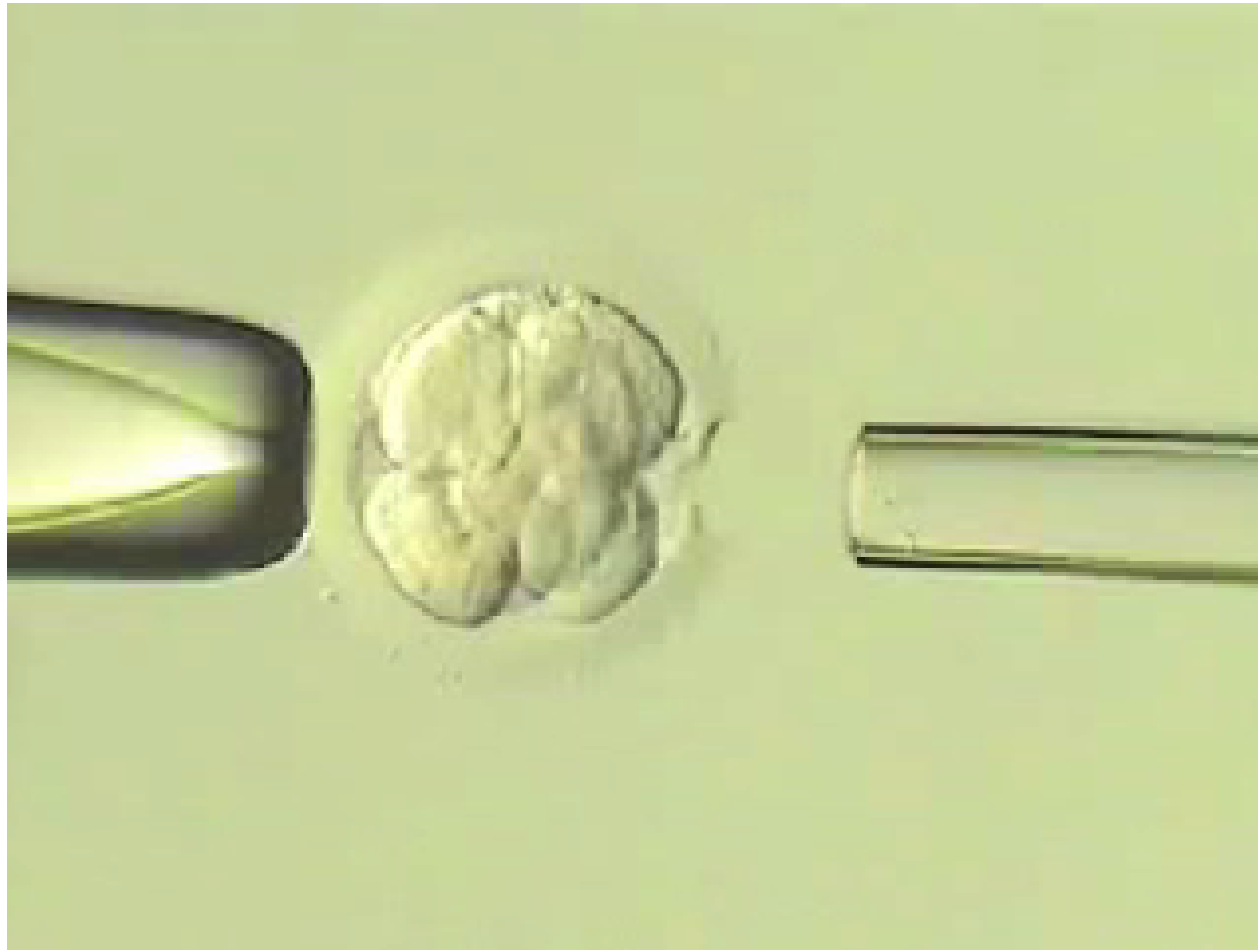
☐ Overview



☐ Region



Determining the Genetic Identity of a Human Embryo Before Implantation!

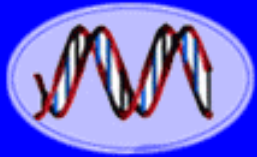


Prenatal Genetic Diagnosis (PGD)

Genetically Engineered Drugs to Treat Human Diseases

Some Medically Useful Products of Biotechnology

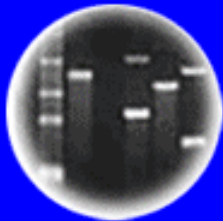
PRODUCT	USE
Colony-stimulating factor	Stimulates production of white blood cells in patients with cancer and AIDS
Erythropoietin	Prevents anemia in patients undergoing kidney dialysis and cancer therapy
Factor VIII	Replaces clotting factor missing in patients with hemophilia A
Growth hormone	Replaces 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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DNA Fingerprinting



Cloning: Ethical Issues
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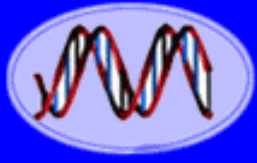


Plants of Tomorrow

What Is A Gene?

What Do Your Genes Look Like?

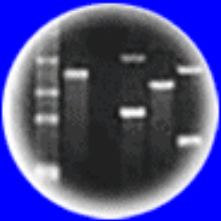
The Origins of Genetic Engineering



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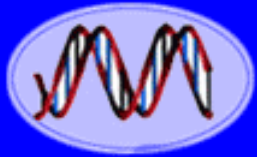


Plants of Tomorrow

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

**With An Unexpected “Eureka”
Moment Dealing With Two Unrelated
Areas of Study:**

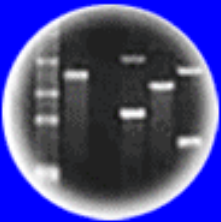
- 1. The Mechanism of Bacterial
Antibiotic Resistance**
- 2. How Novel Enzymes That Protect
Bacteria From Destruction By
Viruses “Cut” DNA Into Pieces**



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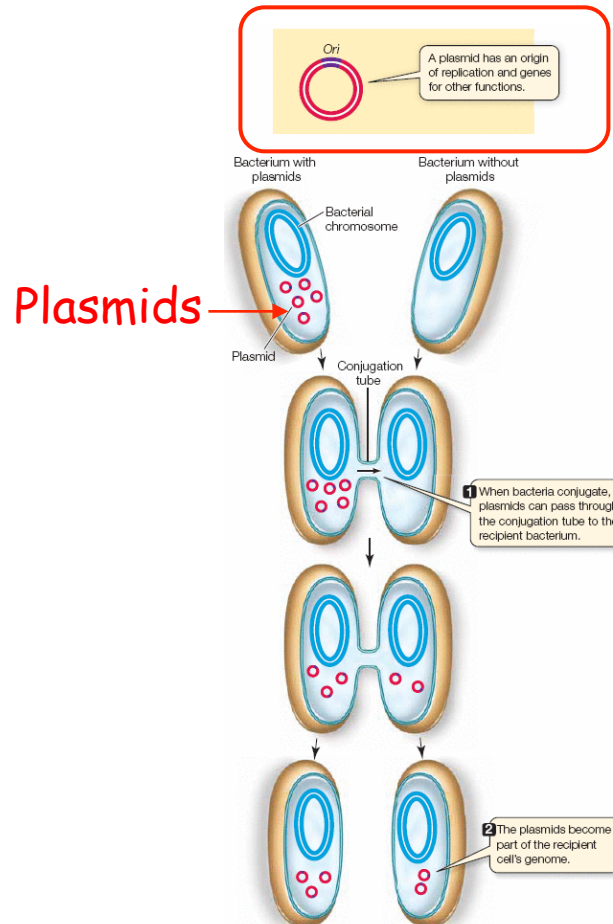


Cloning: Ethical Issues
and Future Consequences



Plants of Tomorrow

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

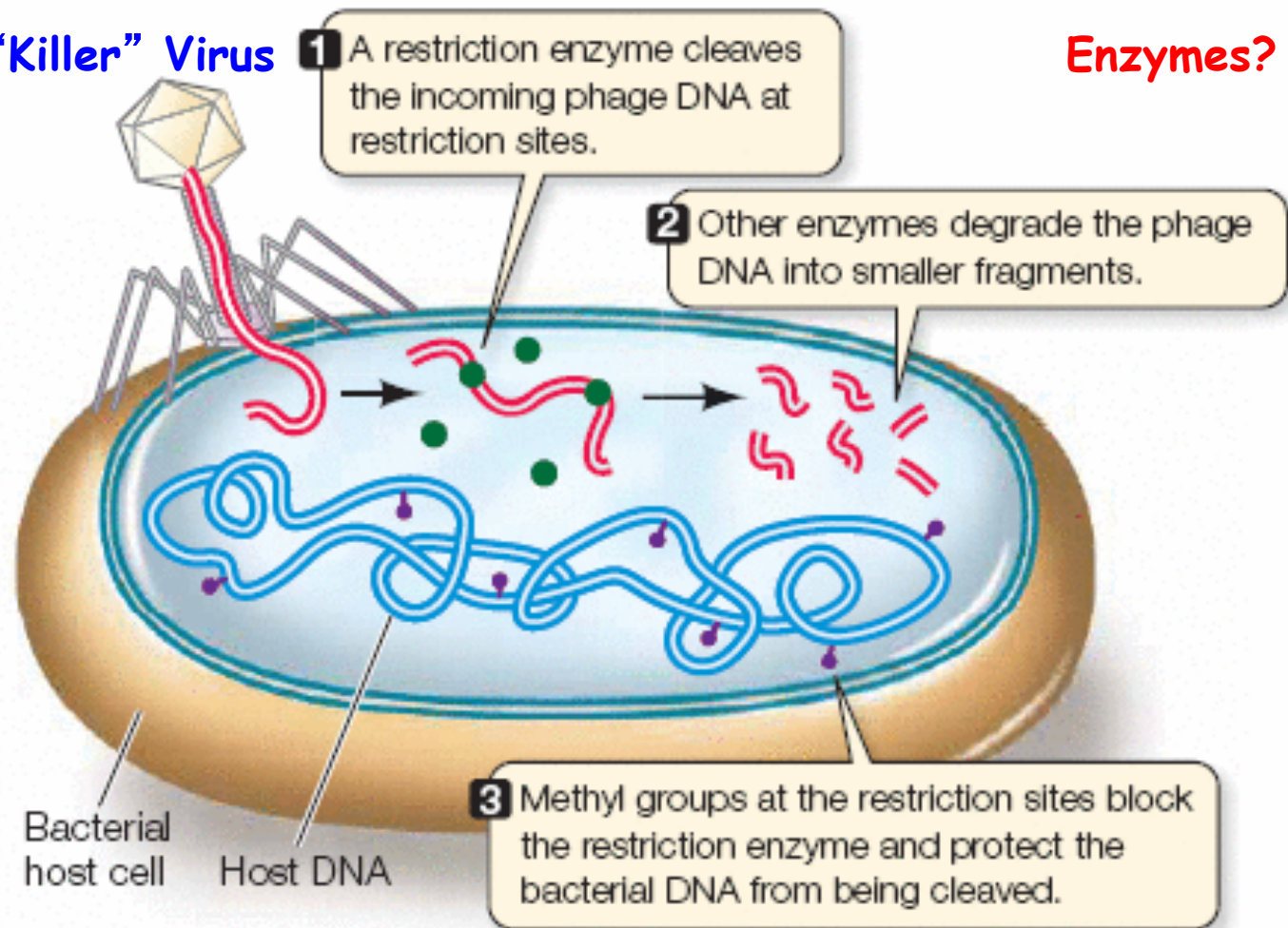


Plasmids Defend Bacteria Against Antibiotics!

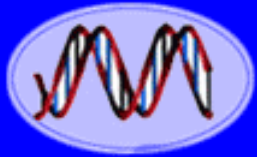
Restriction Enzymes Are Proteins That “Cut” DNA Into Pieces

Enzymes?

“Killer” Virus



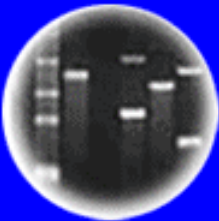
Restriction Enzymes Protect Bacteria From “Killer” Viruses!



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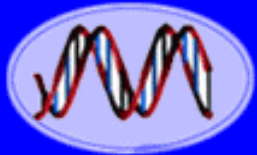


Cloning: Ethical Issues
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Plants of Tomorrow

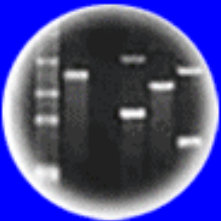
Restriction Enzymes Are Proteins That “Cut” DNA Into Pieces At Specific Sequences



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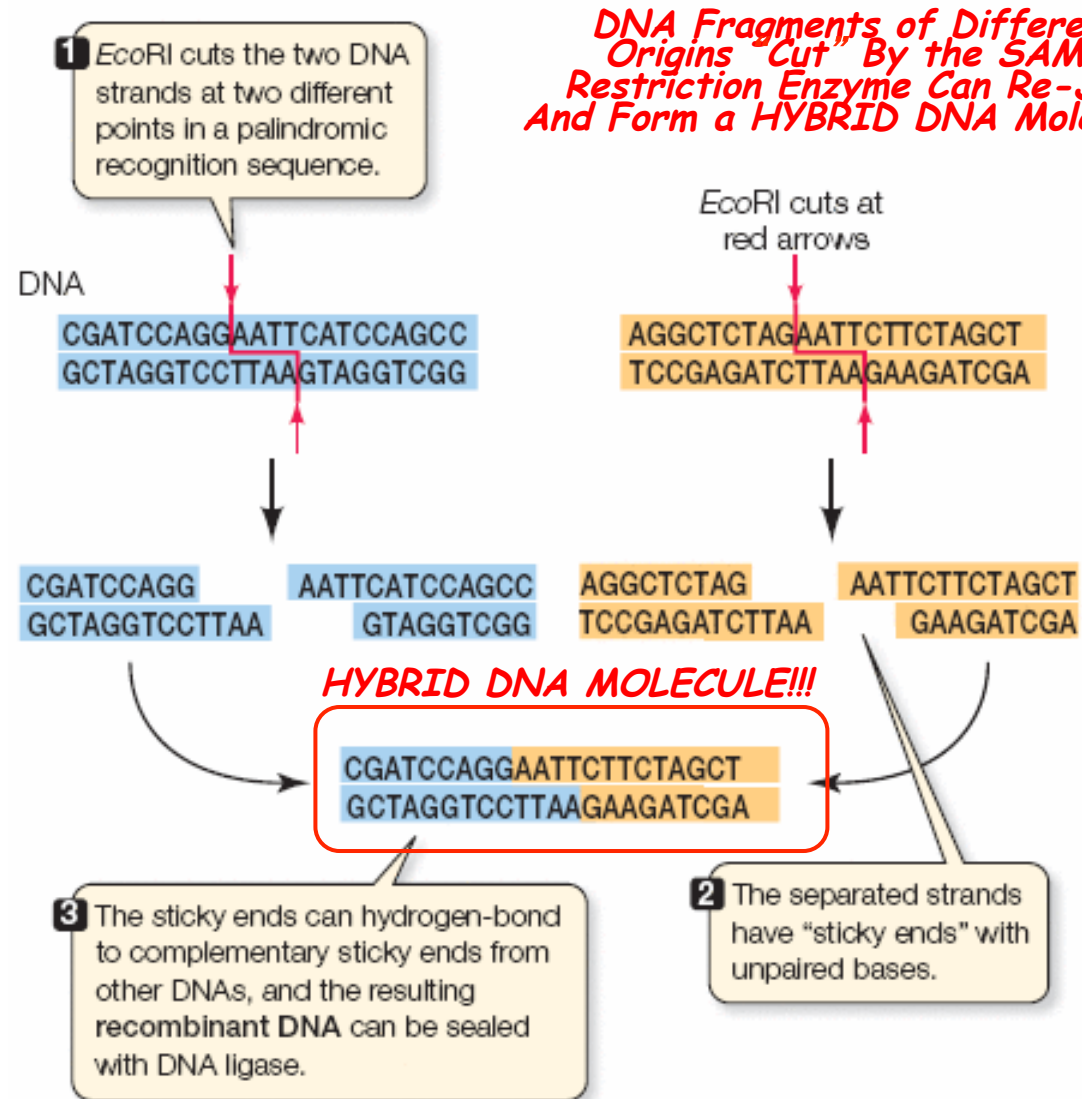
DNA Fingerprinting

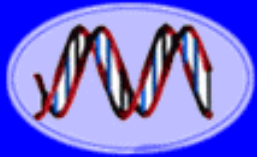


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Plants of Tomorrow

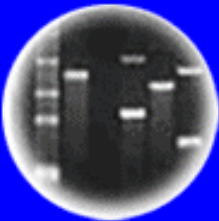




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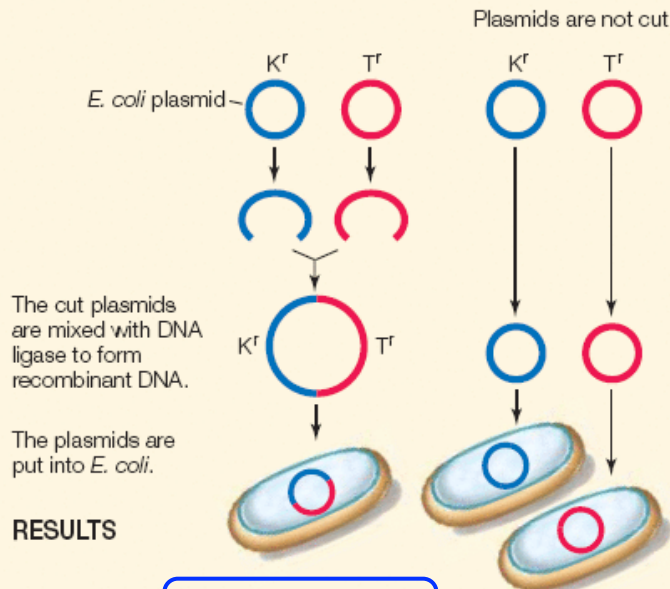
Plants of Tomorrow

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

EXPERIMENT

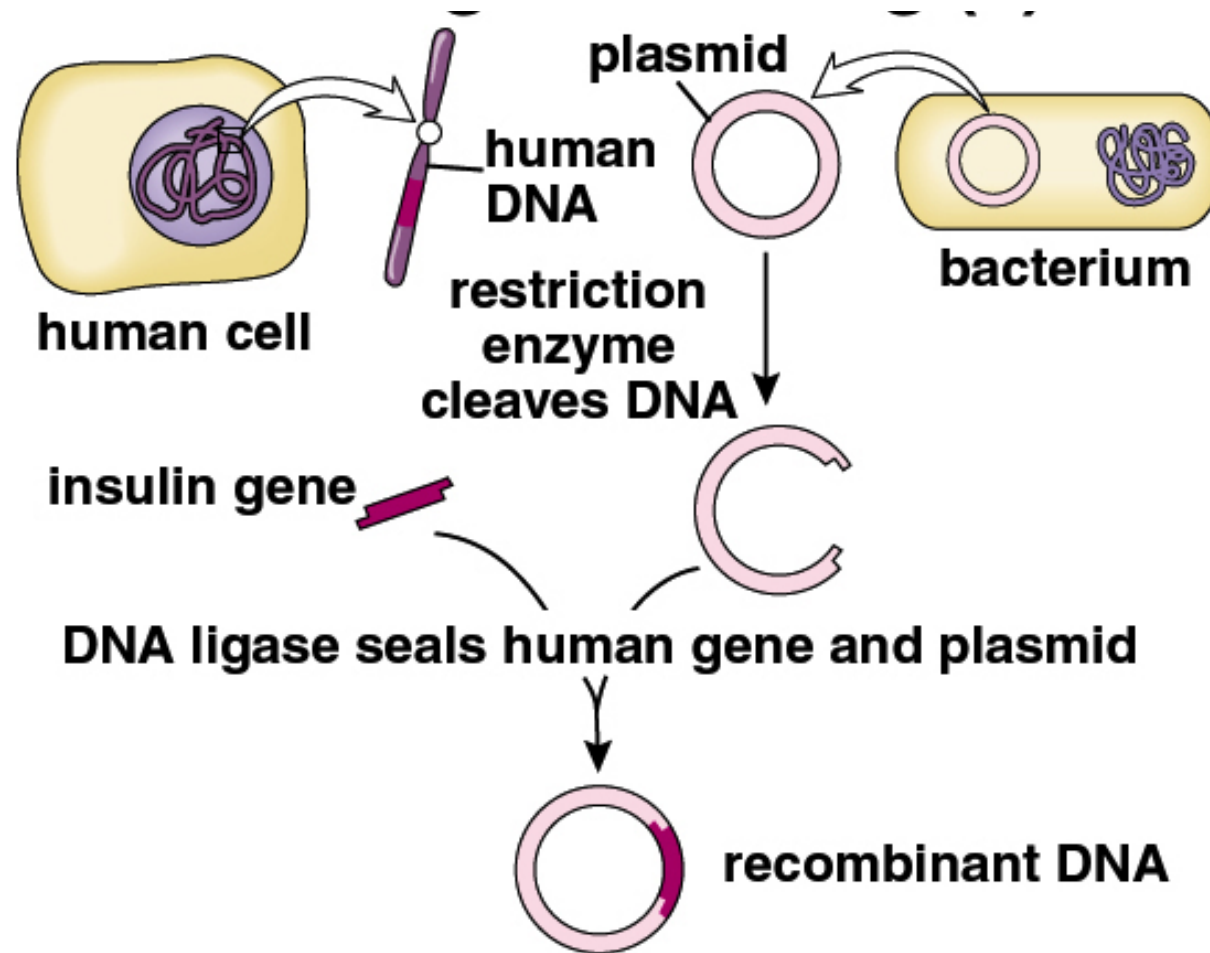
HYPOTHESIS: Biologically functional recombinant chromosomes can be made in the laboratory.

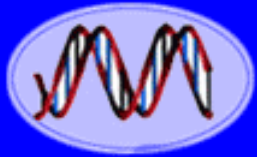
METHOD *E. coli* plasmids carrying a gene for resistance to either the antibiotic kanamycin or tetracycline are cut with a restriction enzyme.



CONCLUSION: Two DNA fragments with different genes can be joined to make a recombinant DNA molecule, and the resulting DNA is functional.

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

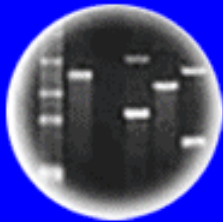




DNA
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DNA Fingerprinting

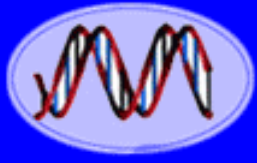


Cloning: Ethical Issues
and Future Consequences



Plants of Tomorrow

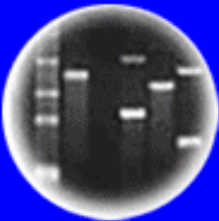
Leading to a **REVOLUTION** in
Technology and Making it Possible
For the First Time to Isolate,
Manipulate, and Study Genes



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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!

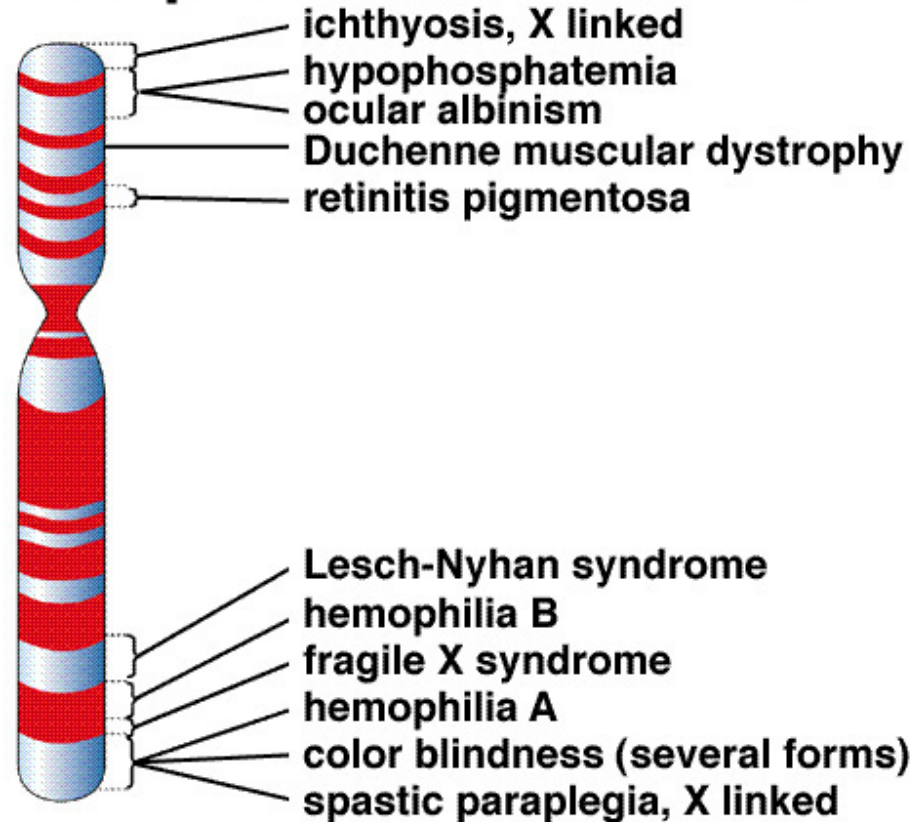
For Example: Human Genes in
Bacteria, Bacterial Genes in
Plants, Jellyfish Genes in
Monkeys, etc., etc., etc., etc.

What is Genetic Engineering & What Does It Do?

Genomes & Chromosomes Contain Thousands of Genes

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Map of chromosome X



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) And Many Other Uses

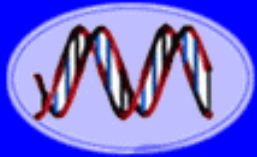
Genetic Engineering Has Lead to New Knowledge About How Cells and Genes Function and Has Lead to Applications That Have Improved Our Lives!!

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

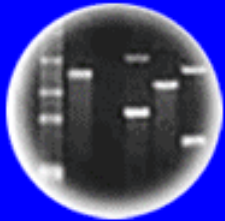
1. Patenting Genes, Cells, & Living Organisms?
2. Regulating Experimentation on DNA, Cells, Transgenic Organisms ("GMOs")?
3. Regulating the Release of Genetically Modified Organisms into the Environment?
4. Labeling of Genetically Modified Foods?
5. Genetic Testing: DNA Databases, Newborn Genetic Screening, 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?



DNA
Genetic Code of Life



Entire Genetic Code
of a Bacteria



DNA Fingerprinting



Cloning: Ethical Issues
and Future Consequences



Plants of Tomorrow

What Can Be Done? A Few Examples!

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



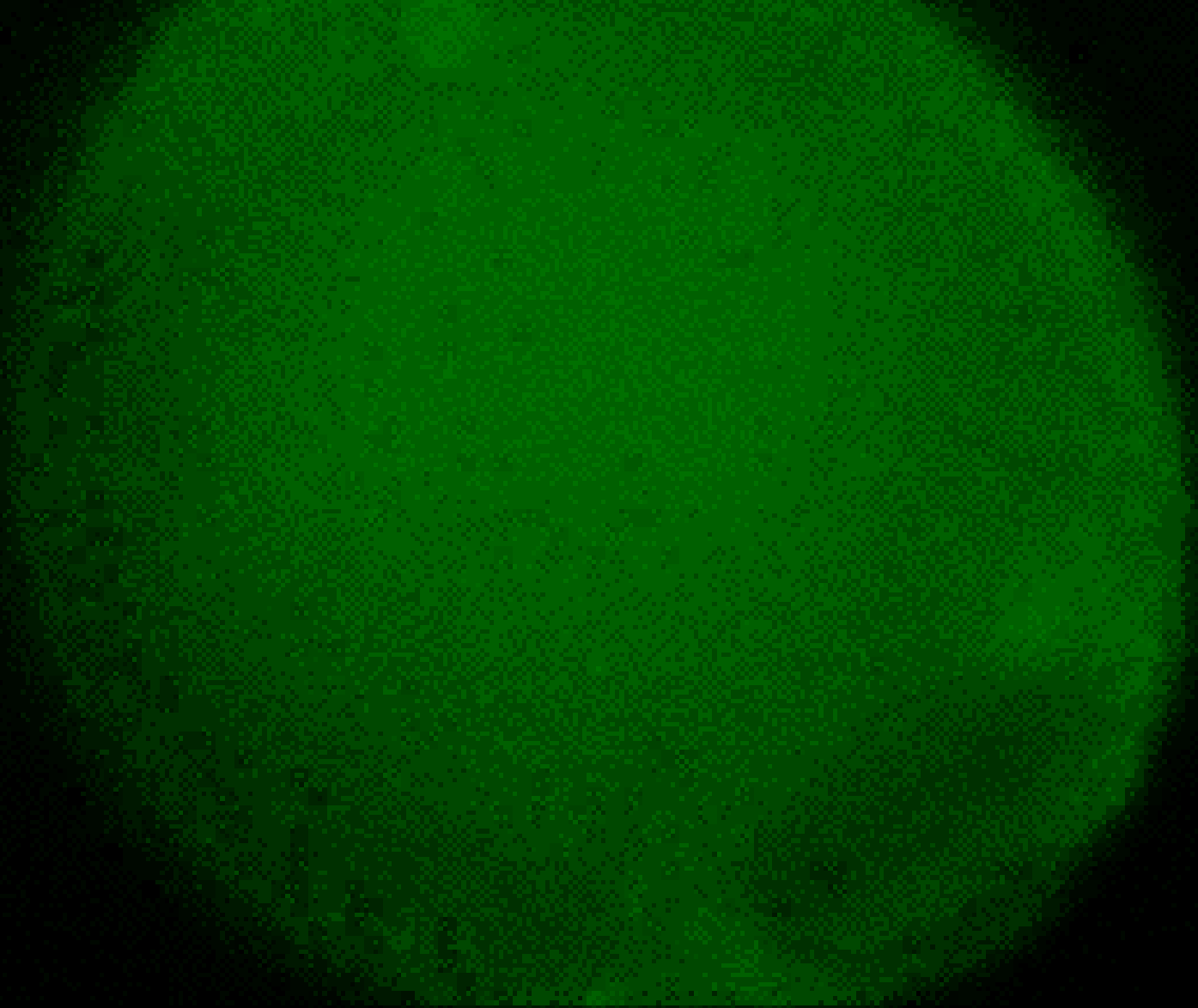
Green Fluorescence Protein



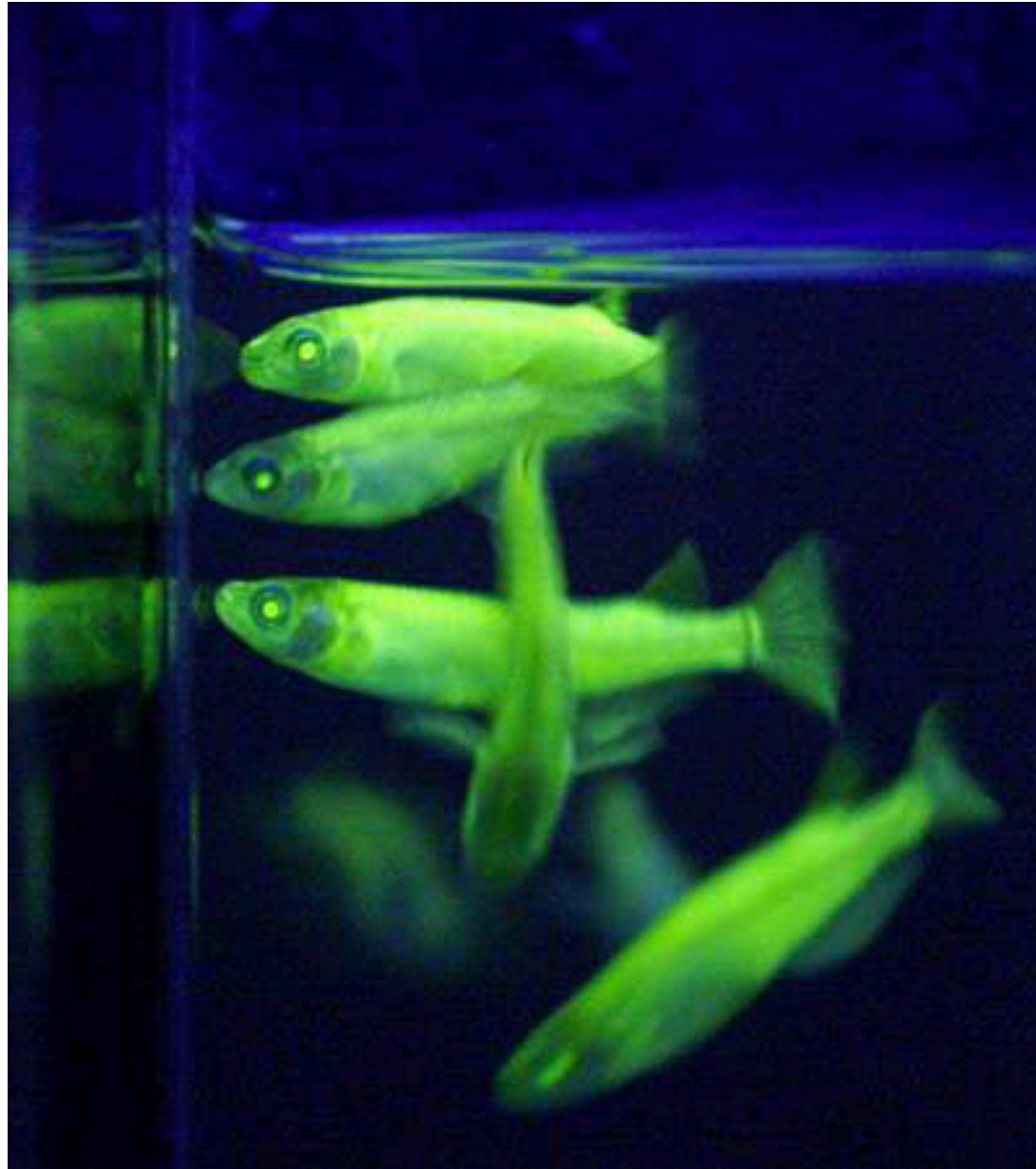
Making a "GloFish".....

*.....Using Genetic Engineering &
A Jellyfish Gene!!!*

A “GloFish” Embryo!!!!



A “GloFish!!!!”



GloFish Fluorescing With Different Colors!!



Engineering GloFish to Fluoresce Different Colors!!

Fluorescent transgenic zebrafish were developed by a research team, led by Dr. Z. Gong, in Department of Biological Sciences, National University of Singapore.

Fig. 1. The basic procedure to produce transgenic fish. Briefly, fluorescent color genes, originally isolated from a jellyfish and a sea anemone, were microinjected into zebrafish eggs and these foreign genes later become a part of the genetic make-up of injected zebrafish. Thus the fluorescent color acquired by these transgenic zebrafish can be stably transmitted to all future generations. This technology can also be applied to other ornamental fish species.

General Procedure of Generation of Transgenic fish

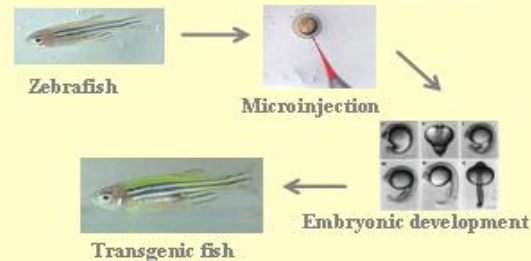


Fig. 2. Florescent transgenic zebrafish in a rainbow array (top to bottom): Red, rfp fish; Orange, rfp/gfp fish; Yellow, yfp fish; Green, gfp fish; and Wild Type fish. The picture on the far left was taken under a daylight and the picture on the left in the dark with a uv light.

rfp – red fluorescent protein
yfp – yellow fluorescent protein
gfp – green fluorescent protein



Fig. 3. Swimming fluorescent transgenic zebrafish under the daylight (top) and in the dark (bottom, with a uv light)

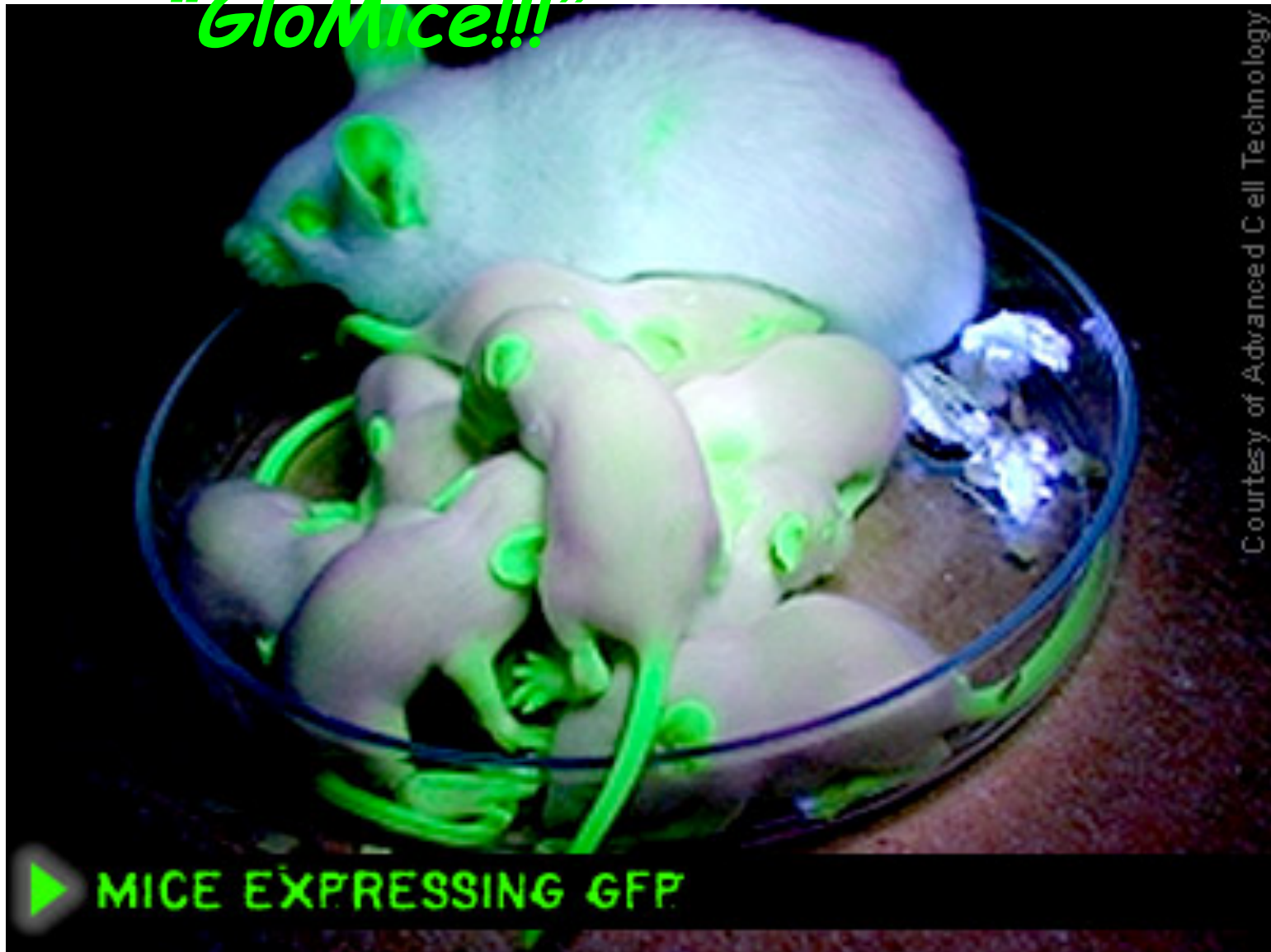


GloFish®

How About a GloFly!



What About "GloMice!!!"

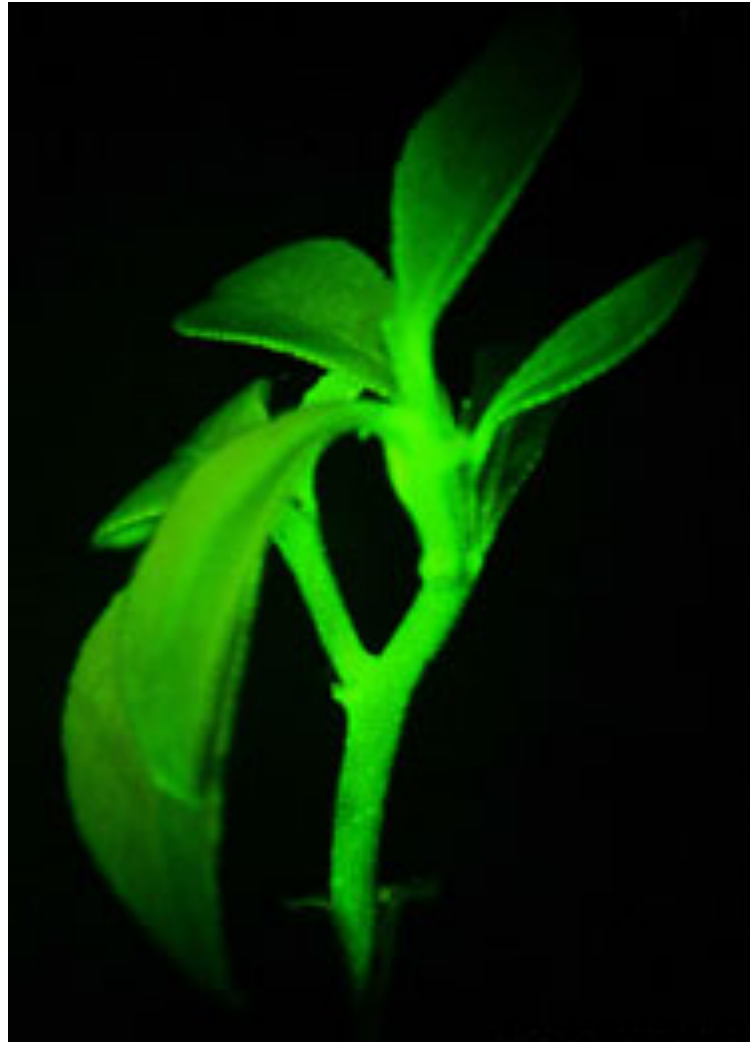


How About a “GloMonkey!!!”



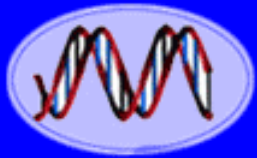
Using red fluorescence protein

A GloPlant With the Same Jellyfish Gene



What are the Philosophical and Biological Implications of These Experiments?

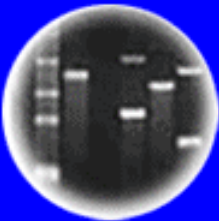
What About Inserting Bacterial Genes Into Plants To Produce a Result With Significant Applications??



DNA
Genetic Code of Life



Entire Genetic Code
of a Bacteria



DNA Fingerprinting



Cloning: Ethical Issues
and Future Consequences




Plants of Tomorrow

GARDEN GUIDE **SUNSET**

WHAT TO DO IN YOUR GARDEN IN SEPTEMBER

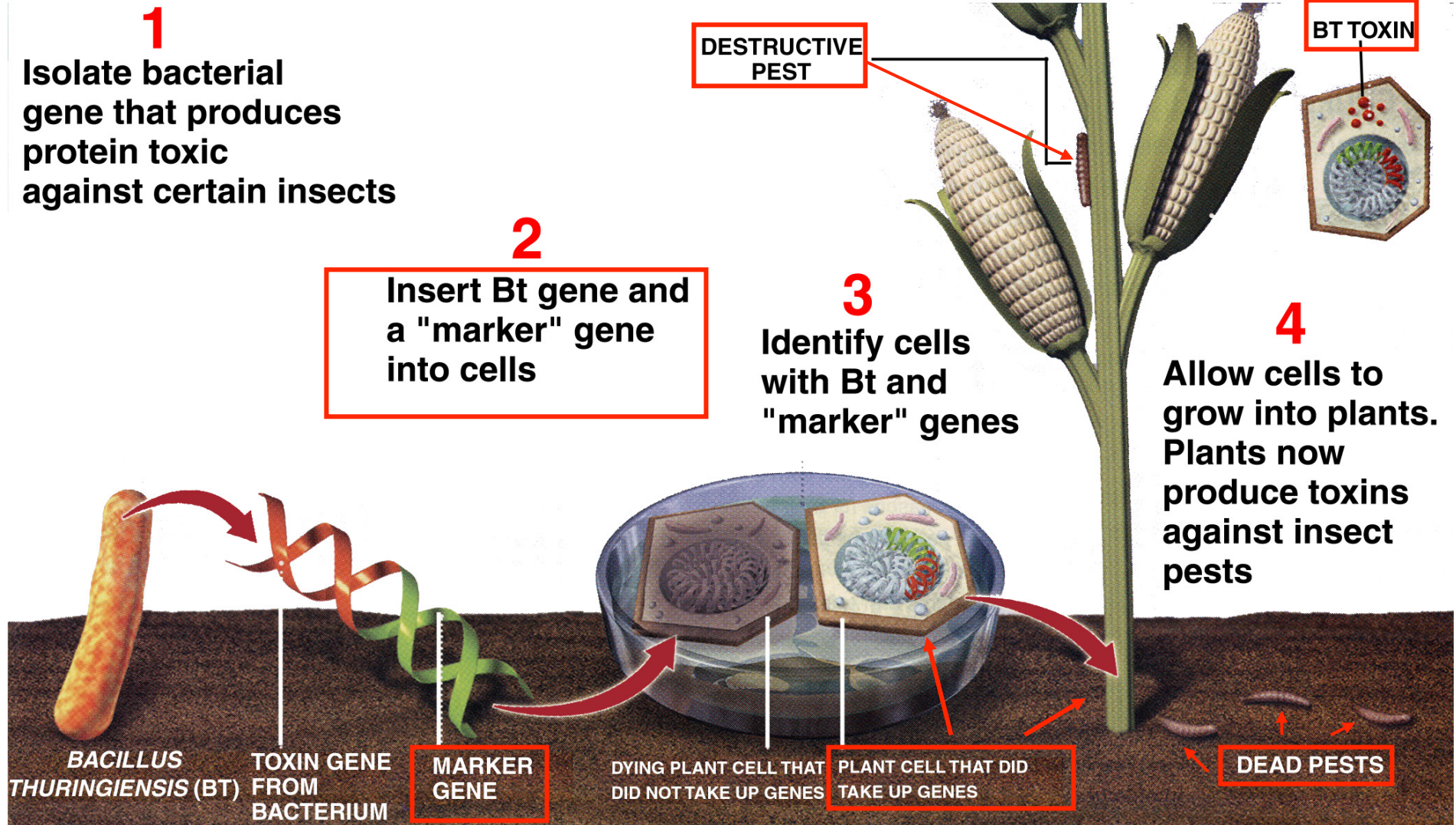
Southern California Checklist



✓ 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. ♦

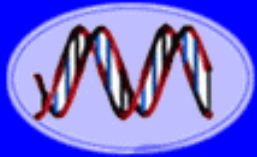
DEBRA LAMBERT

How to Make an Insect-Resistant Plant



Genetic Engineering a Plant to Resist Worms!

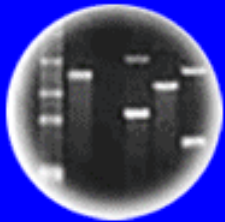




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DNA Fingerprinting

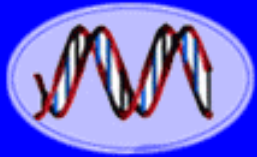


Cloning: Ethical Issues
and Future Consequences



Plants of Tomorrow

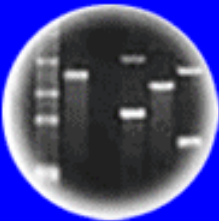
What Else Can Be Done?



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DNA Fingerprinting



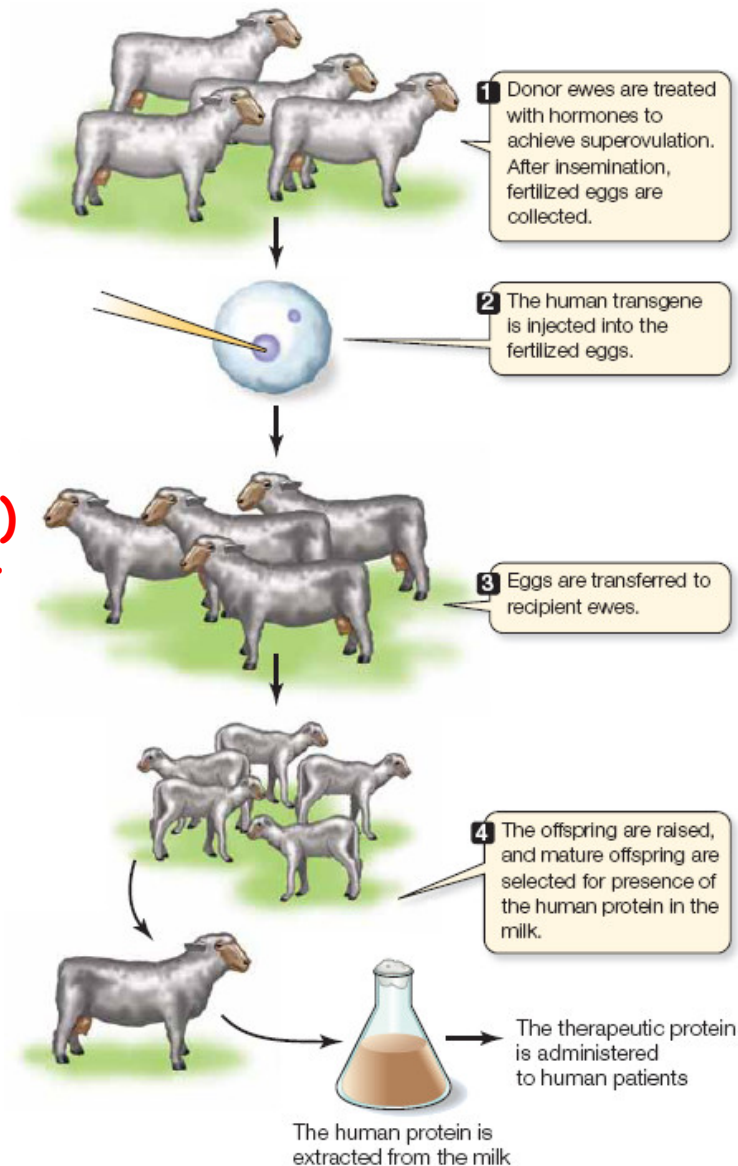
Cloning: Ethical Issues
and Future Consequences



Plants of Tomorrow

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



Even Humans Have Been Genetically Engineered!!

THE

Giving Sight by Therapy With Genes

By PAM BELLUCK
Published: November 2, 2009

Gene therapy has emerged from exile with breakthrough treatments for blindness, cancer, and the deadly bubble boy disease.

By Jill Neimark

Gene therapy for red-green colour blindness in adult primates

Nature, October, 2009

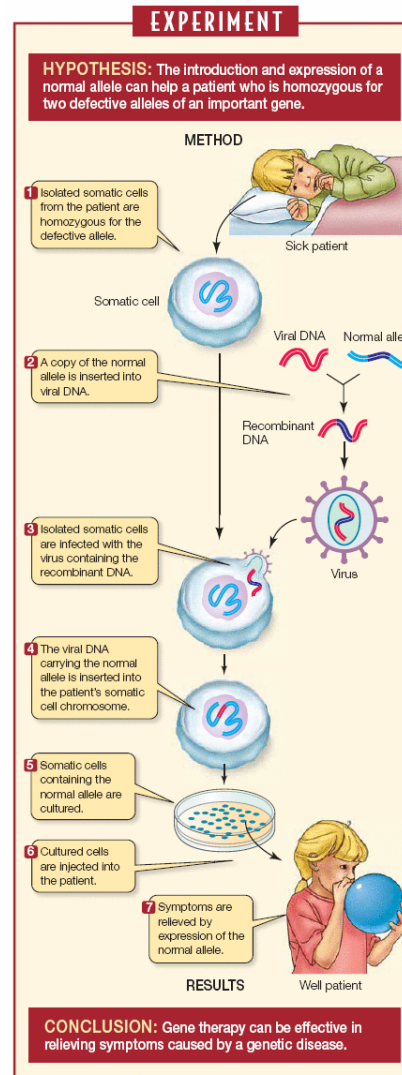
Gene Therapy Helps Blind Children See

By Jocelyn Kaiser
ScienceNOW Daily News
24 October 2009

CURE

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!!!

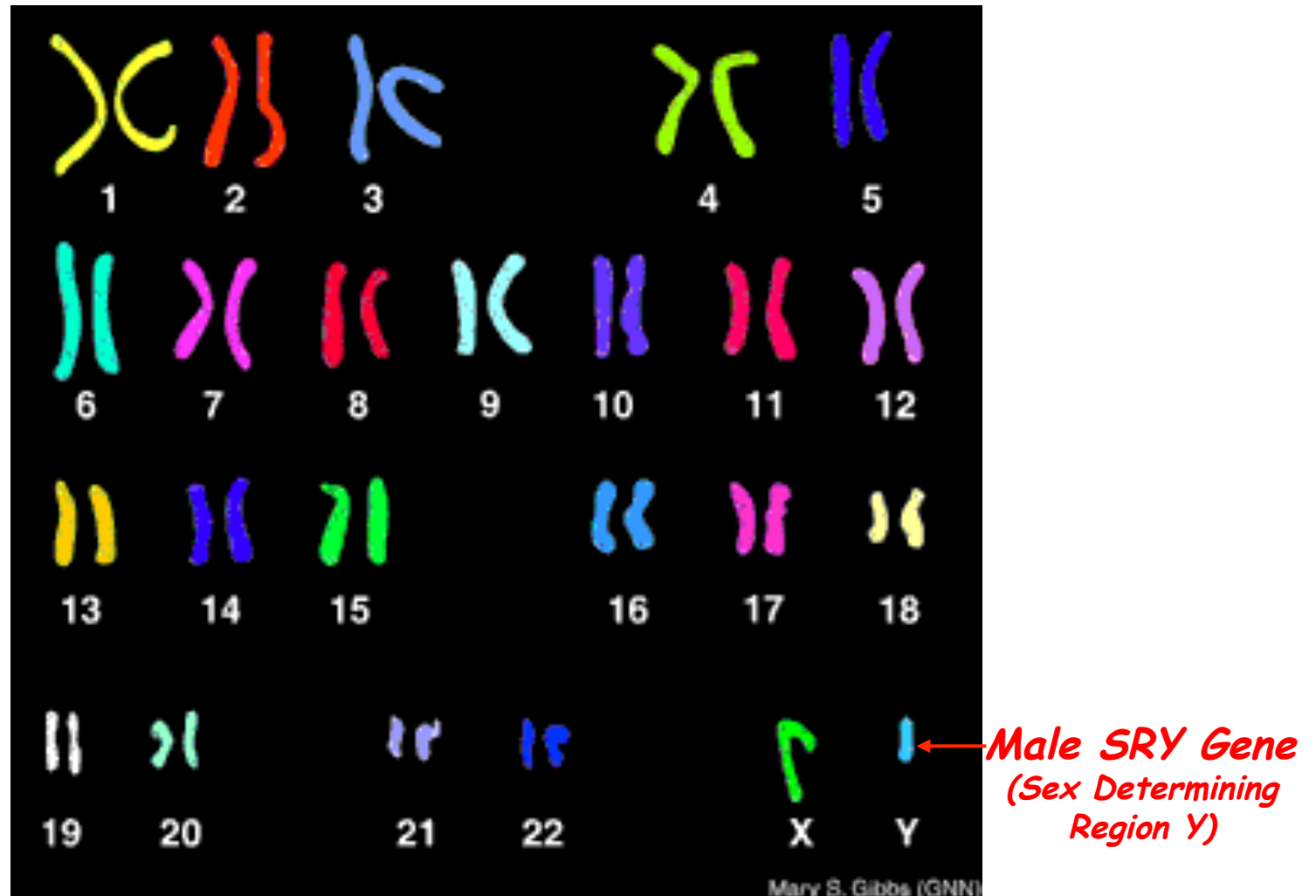


Several Teenagers Are Alive Because They Have Been Engineered With an ADA Gene That They Were Not Born With!!!



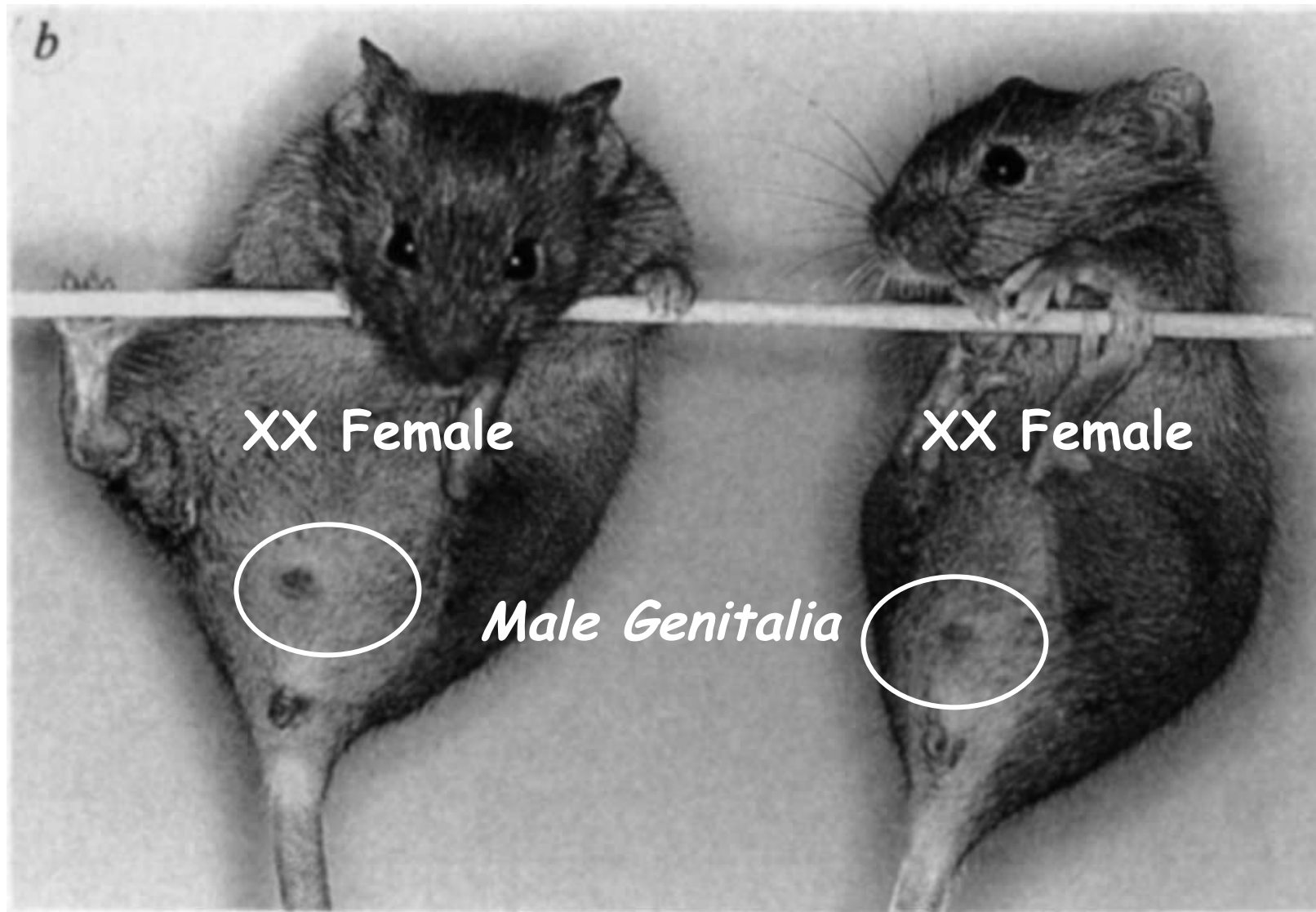
Adenosine Deaminase Gene (ADA)

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



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!!*

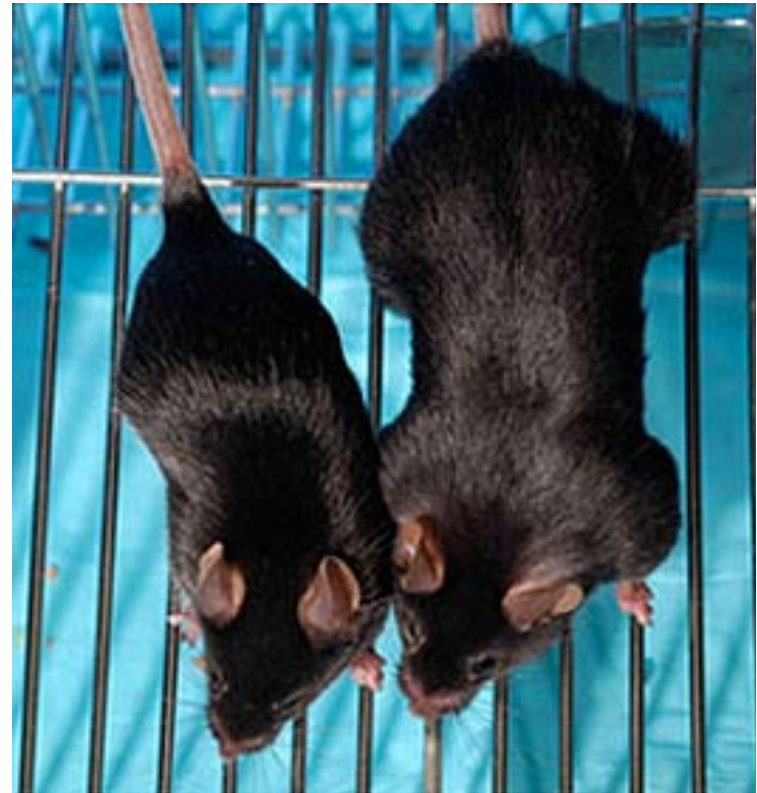
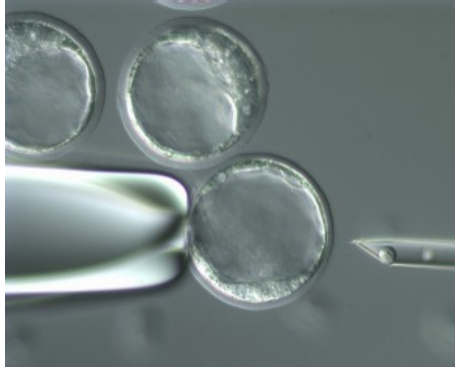
*"So the LORD God caused a deep sleep to fall upon the man, and while he slept took one of his ribs and closed up its place with flesh; and the rib which the LORD God had taken from the man he made into a woman and brought her to the man. Then the man said, "This at last is bone of my bones and flesh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

Making a Mighty Mouse!

Nature, December, 1982
26 Years Ago!
Think About What We
Can Do Now!!!!

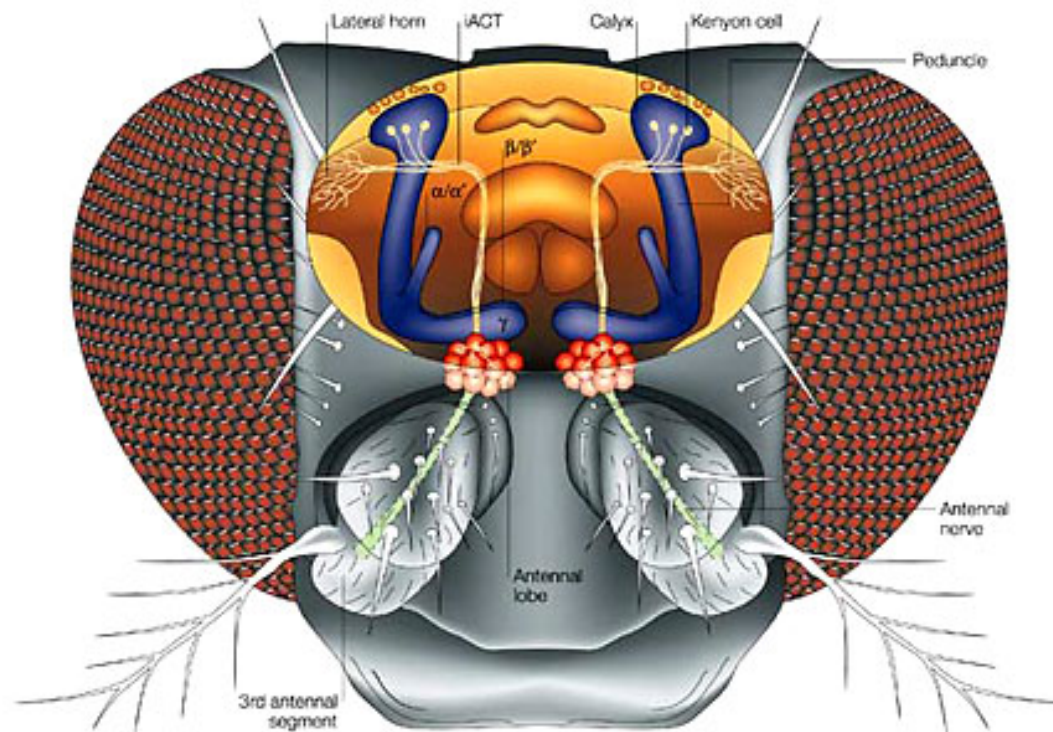


Engineering “Mighty Mouse” With a Rat Growth Hormone Gene



Engineering Memory in a Fly!

Researchers Create Artificial Memories in the Brain of a Fruitfly



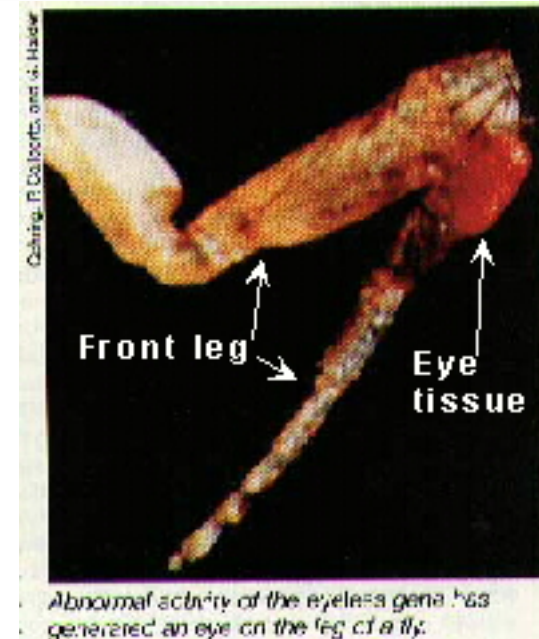
NATURE

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.

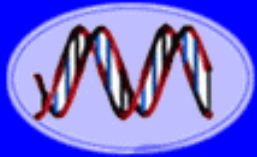
By **NICHOLAS WADE**

Published: October 19, 2009

Engineering Eyes on a Fly's Leg With a Single Gene!



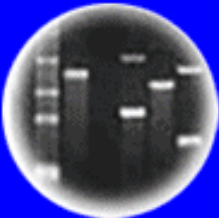
Abnormal activity of the eyeless gene has generated an eye on the leg of a fly.



DNA
Genetic Code of Life



Entire Genetic Code
of a Bacteria



DNA Fingerprinting



Cloning: Ethical Issues
and Future Consequences



Plants of Tomorrow

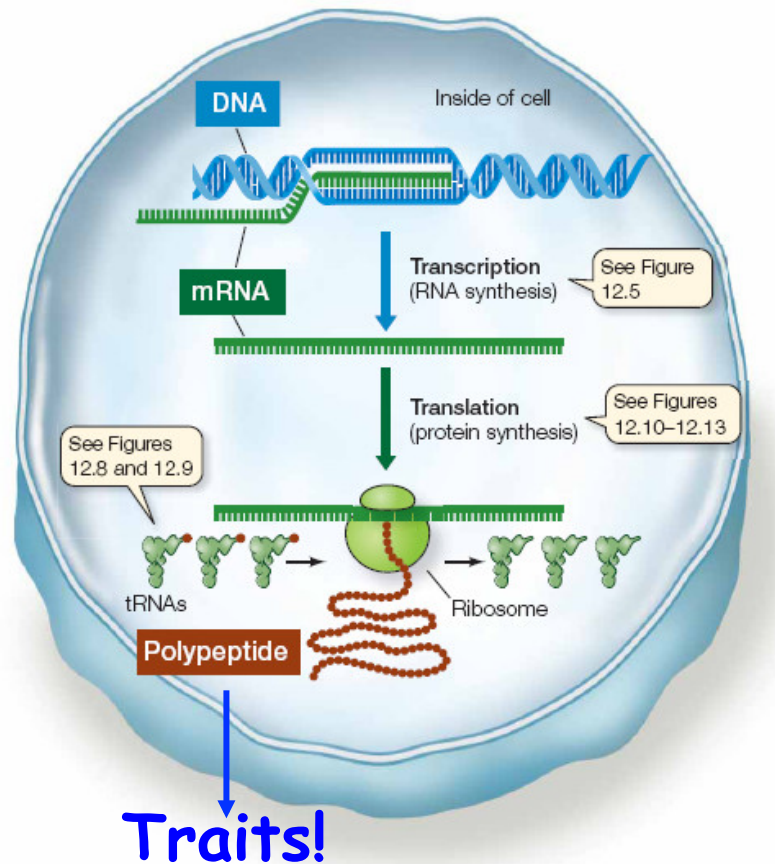
What Do These **Genetic Engineering** Experiments “Say”
About the Unity of Genetic and
Biological Processes?

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 Organisms?

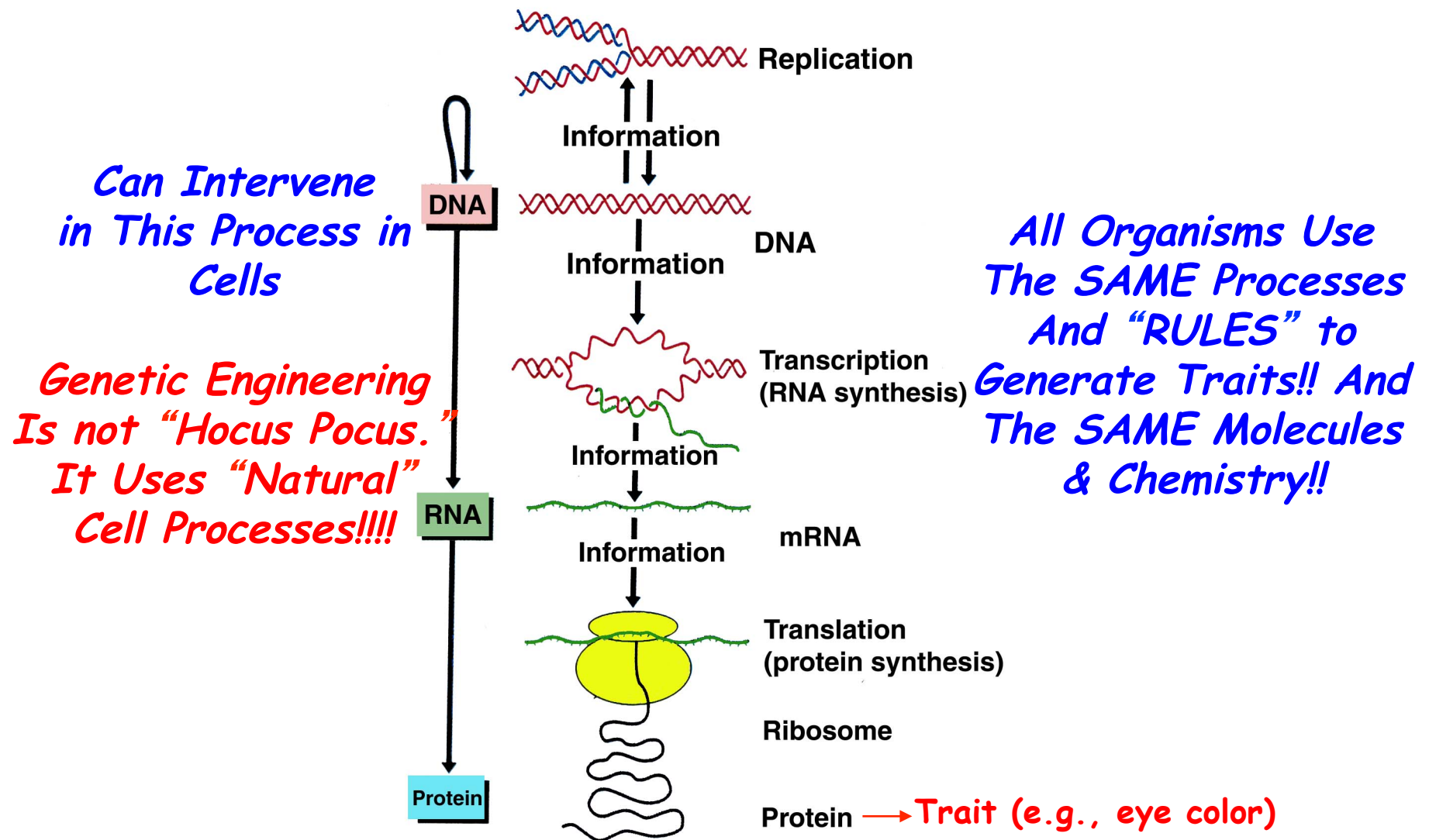


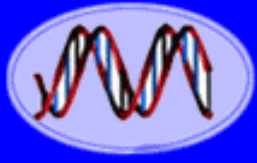
1. *Genes Can Work Independently of Other*
2. *Basic Genetic Processes Are Universal (Replication & DNA to RNA to Protein)*
4. *Basic Genetic Processes Can Be Used to Engineer or Transfer Genes From One Organism to Another and Transfer Them Stably Generation After Generation*

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

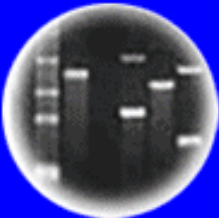




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DNA Fingerprinting



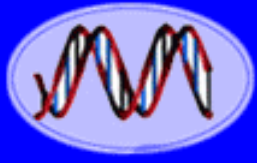
Cloning: Ethical Issues
and Future Consequences



Plants of Tomorrow

The Scientific Method

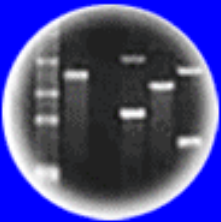
- What are the Observations?
- What is Your Hypothesis to Explain the Observations?
- What are the Predictions?
- How Test Hypothesis?
- What are the Experimental Data?
- Have the Data Been Verified & Peer Reviewed?



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Entire Genetic Code
of a Bacteria



DNA Fingerprinting



Cloning: Ethical Issues
and Future Consequences

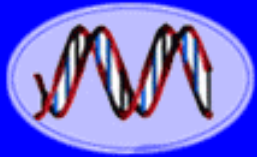


Plants of Tomorrow

Science is NOT “Hocus Pocus”
or Based on Opinions and Beliefs

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

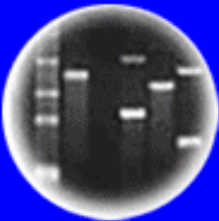
• Technology, or the Application
of Scientific Knowledge, Has
Transformed Dramatically Our
Lives and How We Live



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Entire Genetic Code
of a Bacteria



DNA Fingerprinting



Cloning: Ethical Issues
and Future Consequences



Plants of Tomorrow

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.

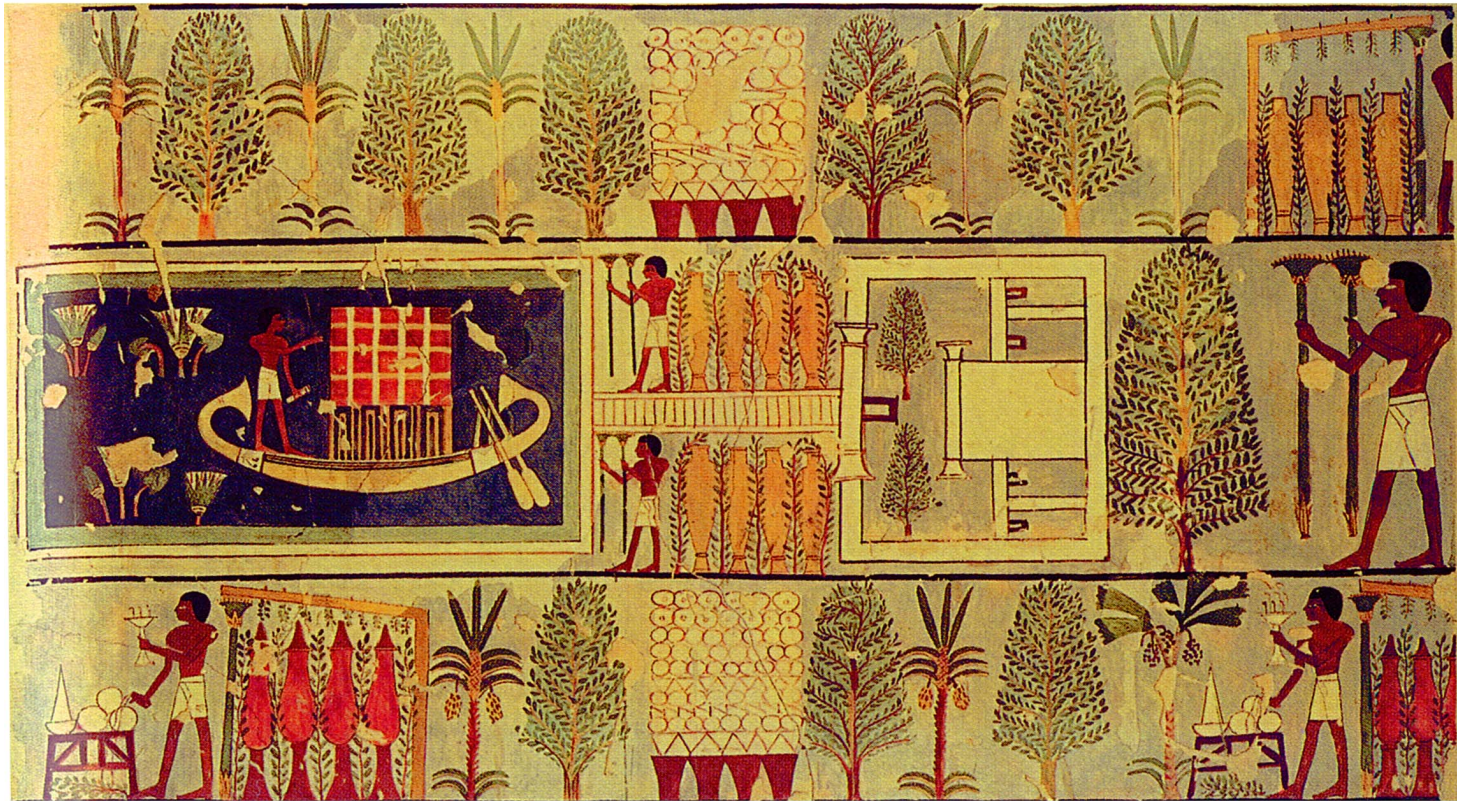
Simply Put:Our Way of Life!

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**

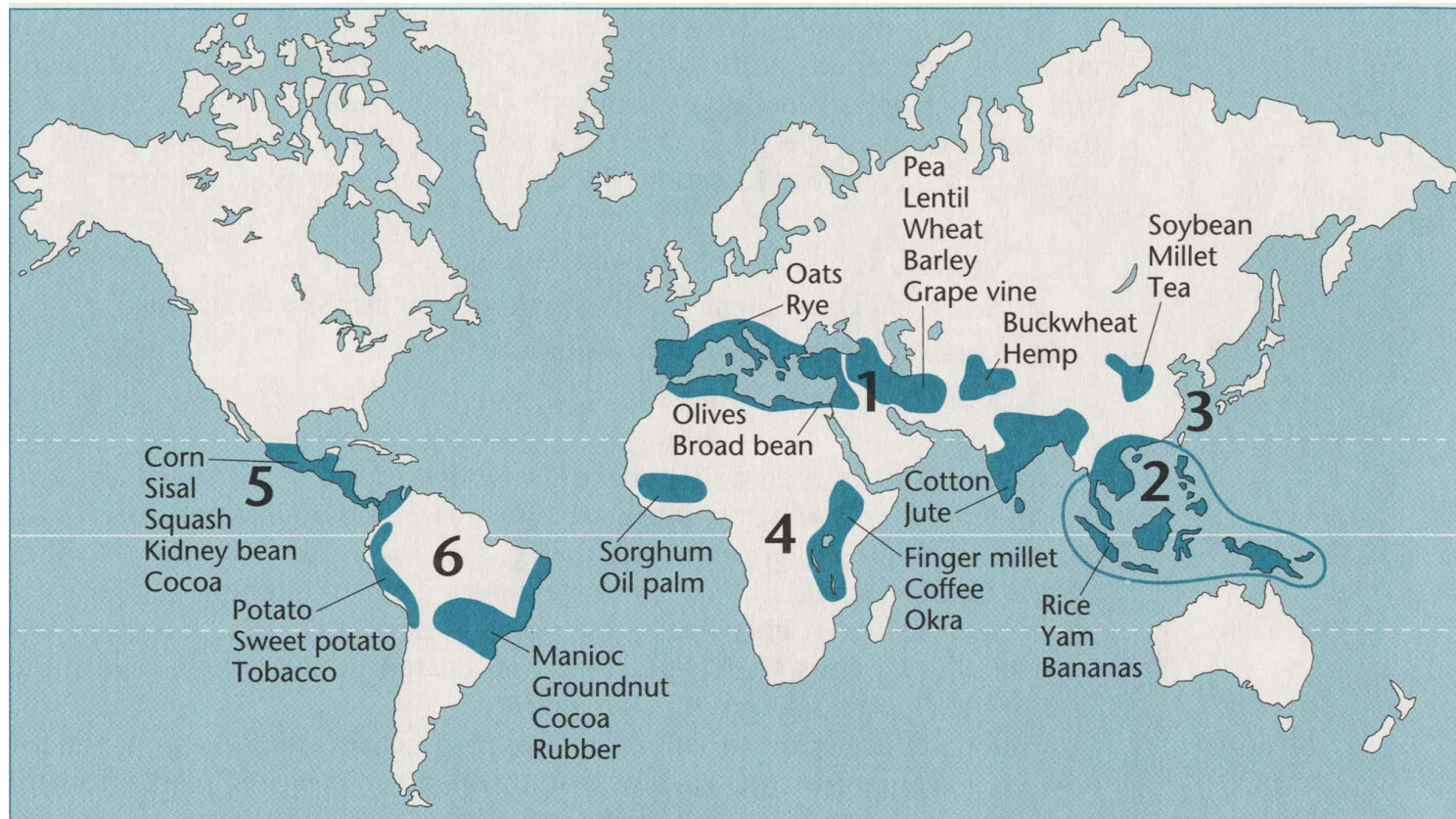


Genetic Engineering is Not New

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

Tomato Genetic Diversity

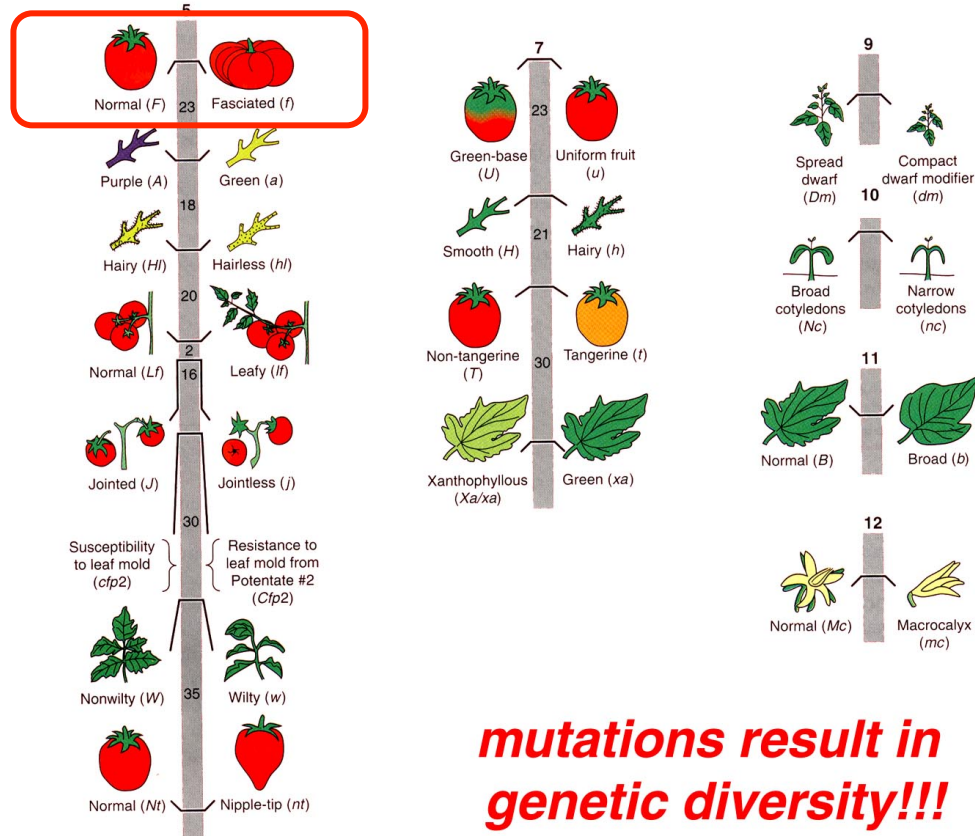
*How Does This
Genetic Variability
Allow Us to Infer
That Genes Exist?*



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

Alternative Forms of the Same Gene Lead to Genetic Diversity

Alleles



mutations result in genetic diversity!!!

Alleles Are Different Forms of the Same Gene That Arise By Mutation & Can be Made in a Laboratory By Modern Genetic Engineering!

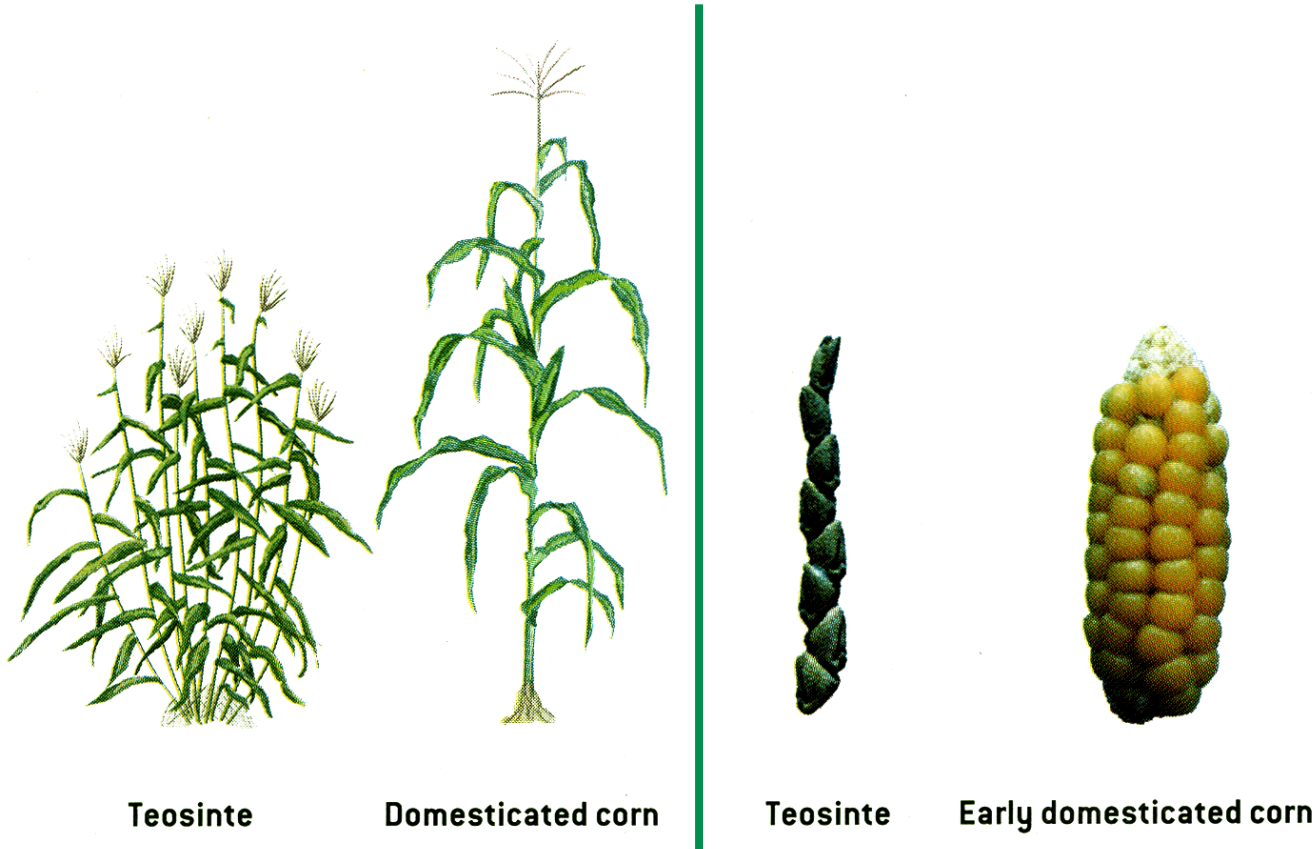
*Tomatoes Were Engineered From Small Wild Relatives
Because of Mutations in Fruit Size Genes!*



*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!

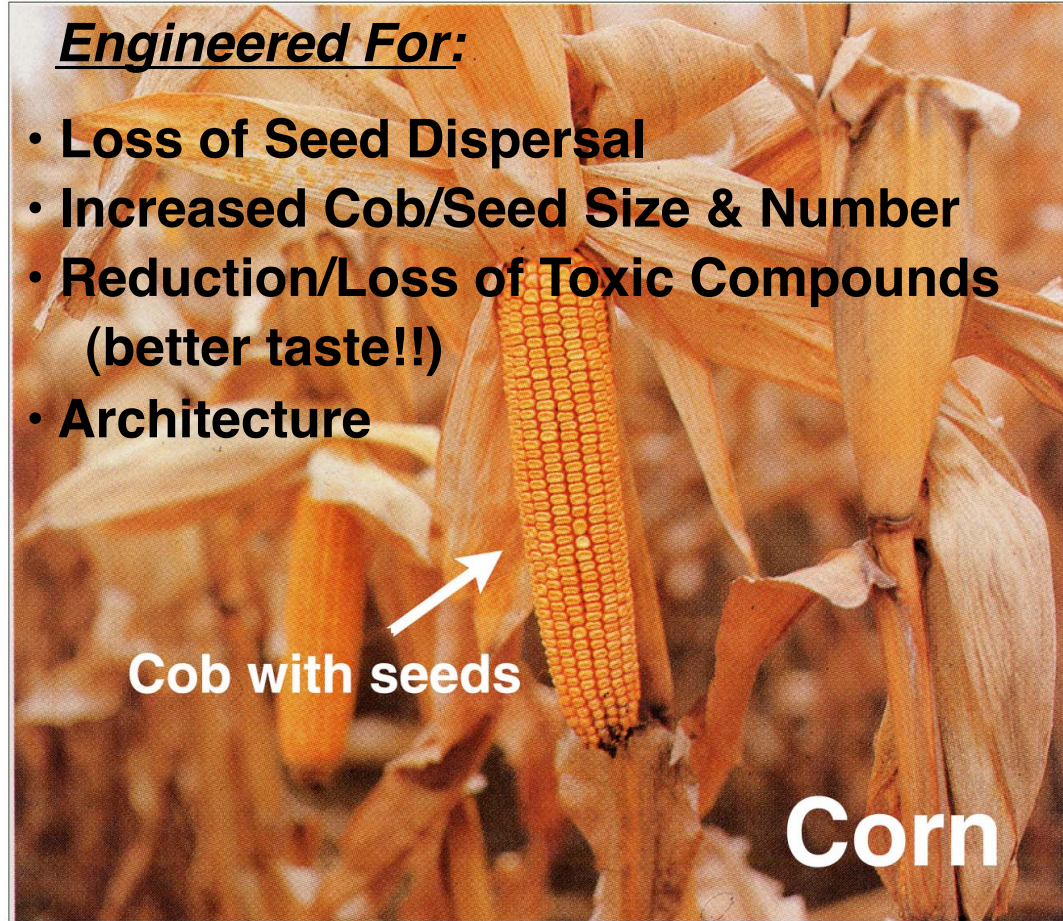
Engineering Teosinte Into Domesticated Corn



Note: *Architecture and Fruit (cob) Size*

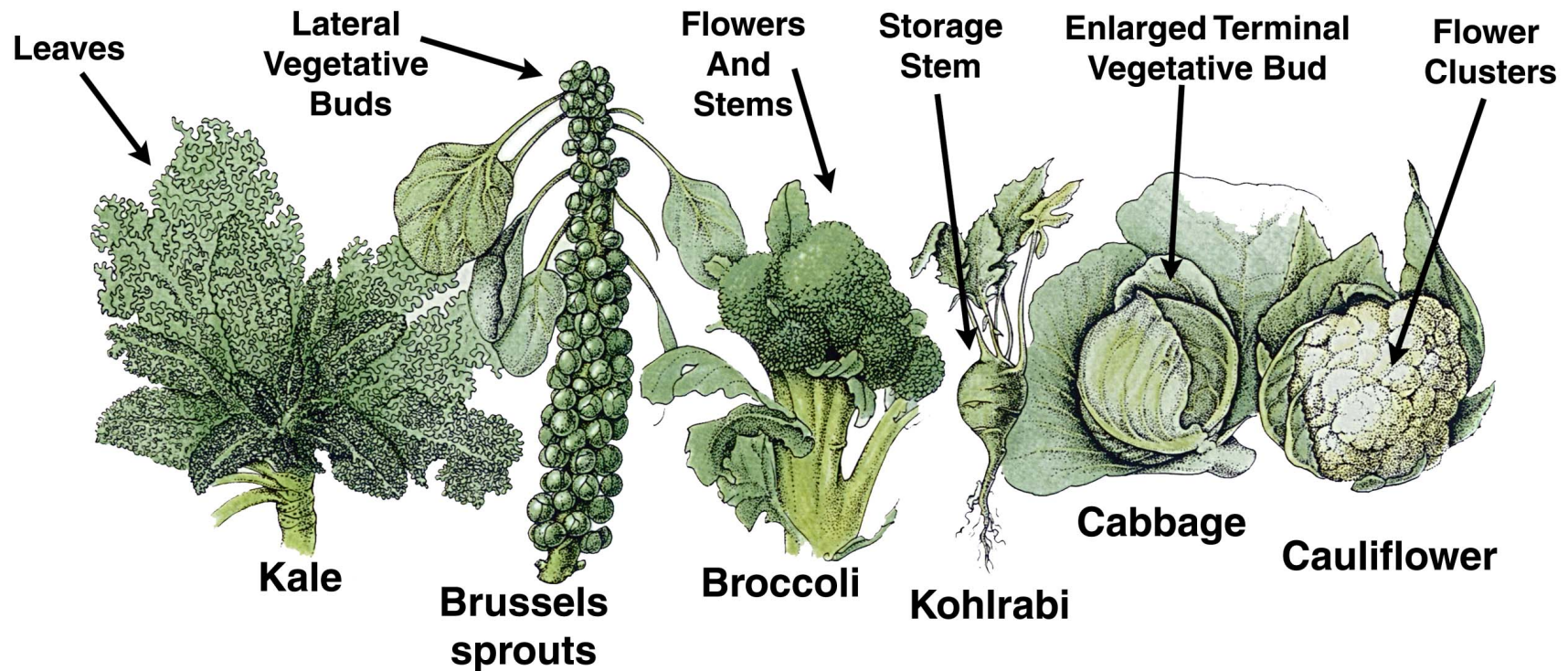
*Only Five Genes Cause These Plants to Differ
& We Now Know What They Are*

Early Breeders Generated Corn From Teosinte



Modern Corn Was “Engineered” From Teosinte 10,000 Years Ago & Cannot Survive in “Nature!!”

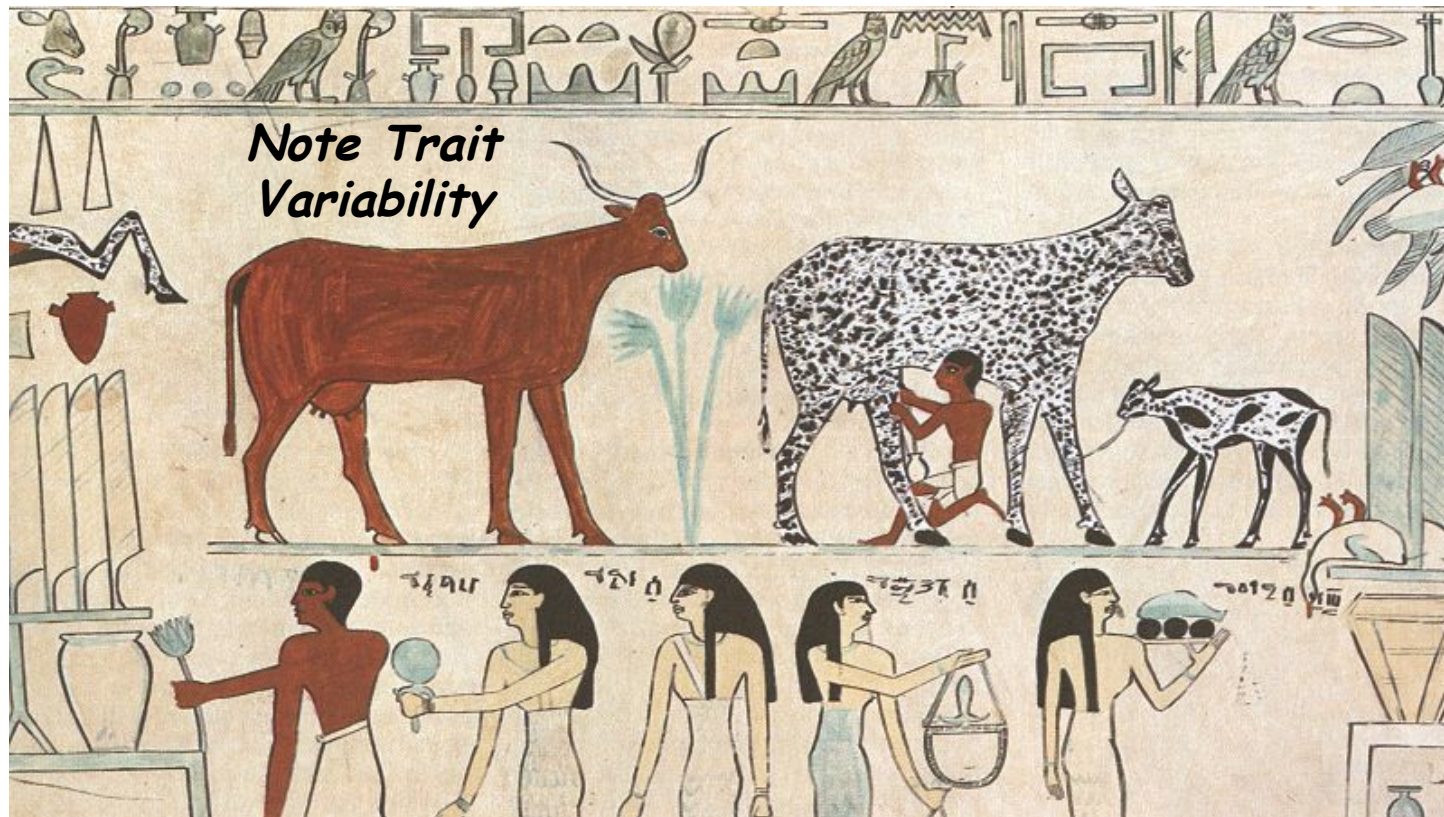
Breeders Have Selected For Variability In Plant Control Genes To Generate Novel Crops



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



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!

Canine DNA
Forensic Testing

The Problem With Breeding the “Old Fashioned Way”

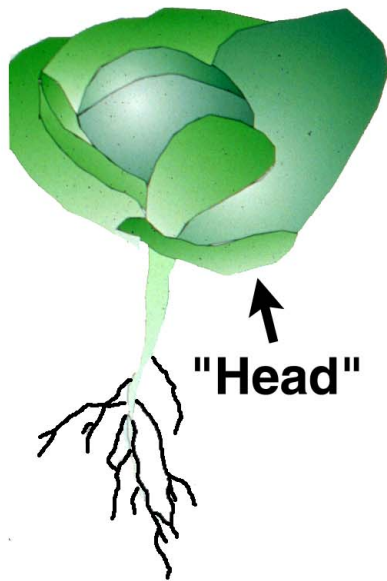
Cannot Predict Results!

The Problem With Breeding the “Old Fashioned Way”

Engineering A Novel Crop By "Wide" Breeding

Cabbage (*Brassica*)

Radish (*Raphanus*)

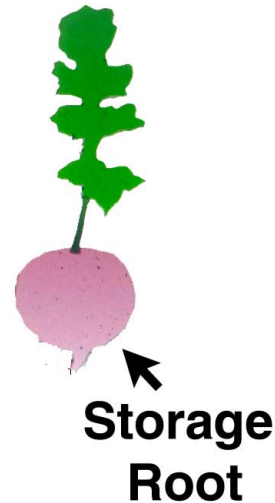


Karpechenko
1925

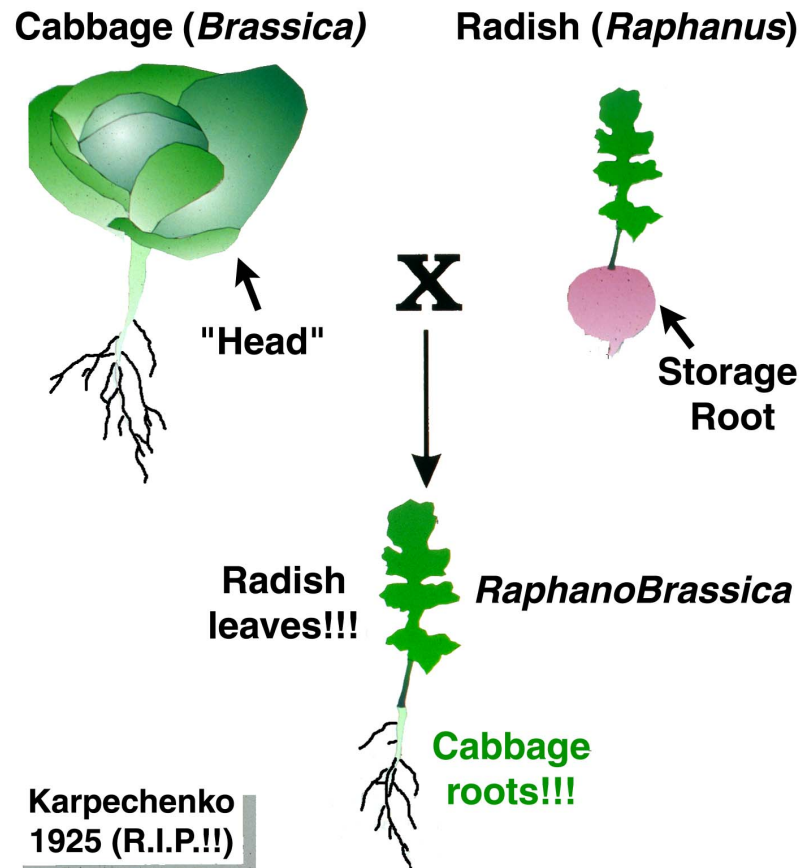
X



???



Engineering A Novel Crop By "Wide" Breeding



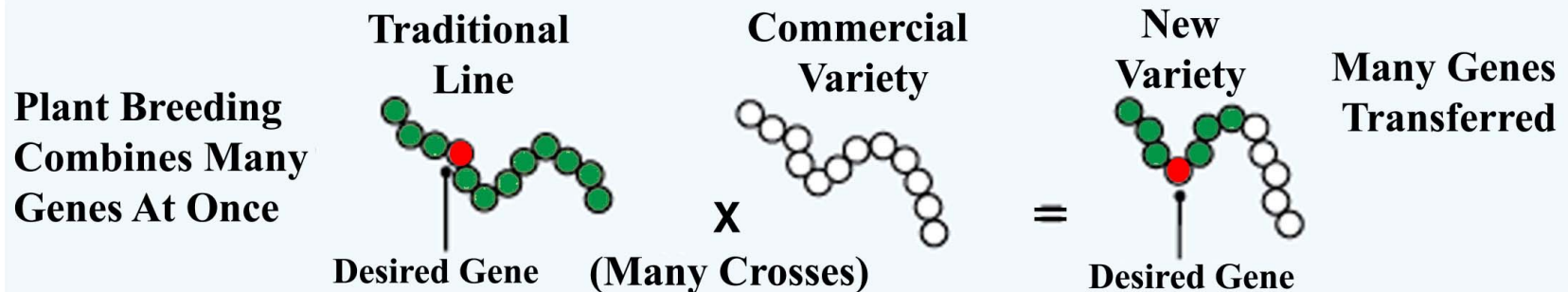
*Results Show the Unpredictability of Classical Breeding Approaches
Compare With the Modern Genetic Engineering Examples Shown Previously*

Genetic Engineering is a Technique!

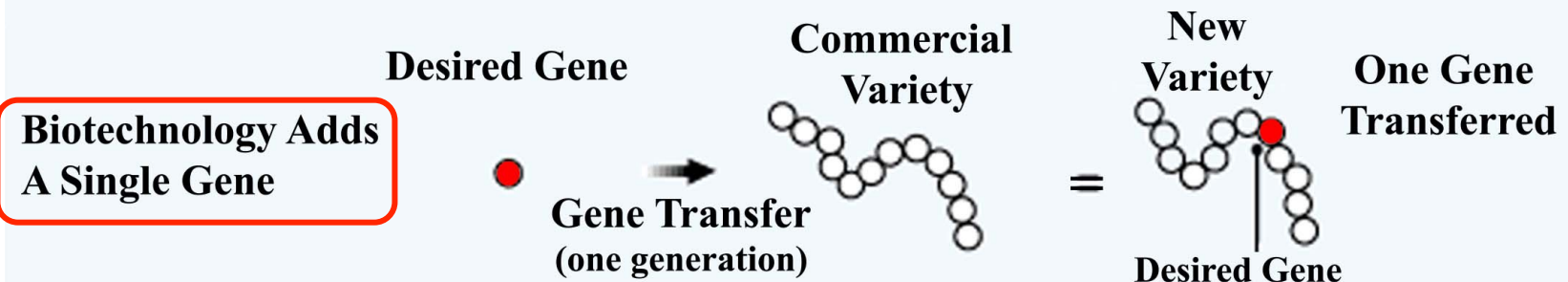
**How Do Classical Genetic Engineering
Methods Differ From Those Using
DNA and 21st Century Technologies?**

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?

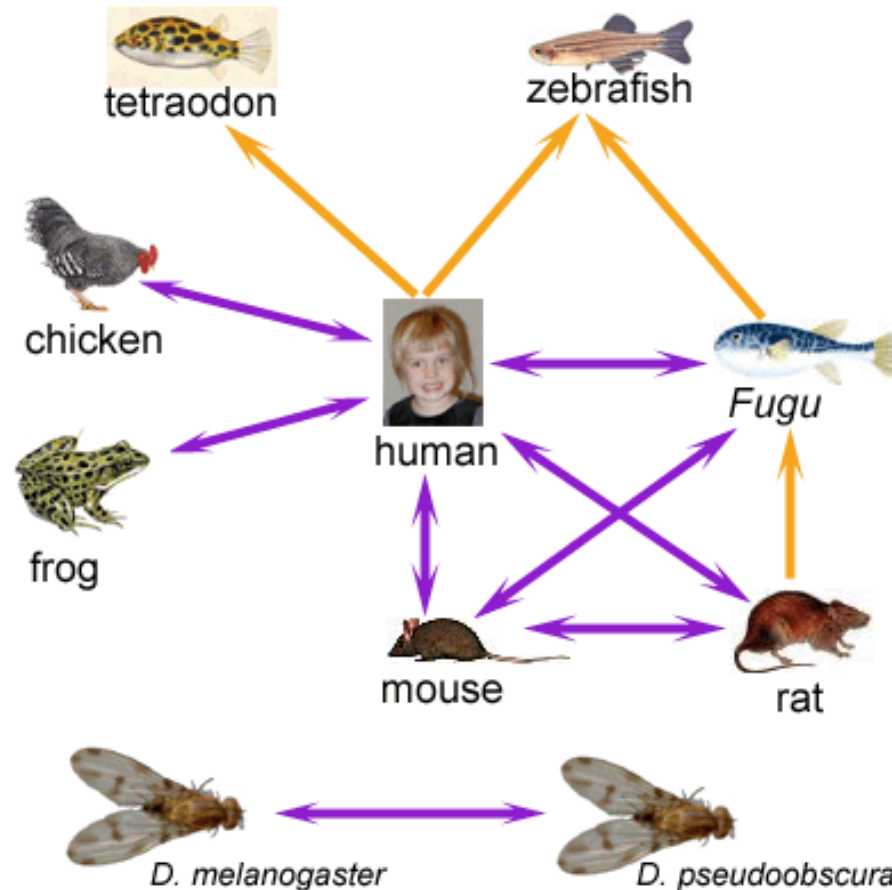
1. Any Gene From Any Organism Can Be Used In Any Organism - There Are No Breeding Barriers (e.g., genes of all sequenced genomes)
2. New Genes Can Be Engineered - Genes That Work Better and/or Produce New Proteins (i.e., create new genetic variability and/or alleles)
3. Existing Genes Can Be Engineered 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

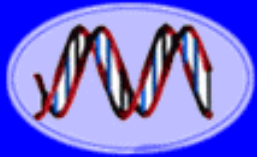


The Genomes of Many Organisms Have Been Sequenced Providing New Knowledge About Our Origins and Cellular Functions

The Future is Unlimited!



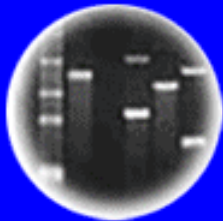
Providing Thousands of New Genes and Proteins To Be Engineered For Practical Applications (e.g., cellulases in termite gut bacteria for biofuel production)



DNA
Genetic Code of Life



Entire Genetic Code
of a Bacteria



DNA Fingerprinting



Cloning: Ethical Issues
and Future Consequences



Plants of Tomorrow

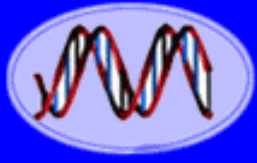
HC70A Winter 2010

Genetic Engineering in Medicine, Agriculture, and Law

Professor Bob Goldberg

Class Announcements

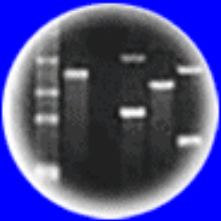
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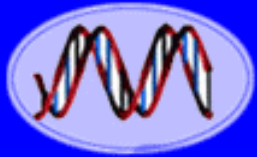
Plants of Tomorrow

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

Discussion

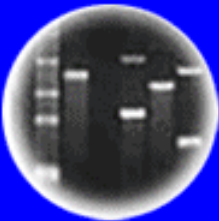
- Come PREPARED!!!!!!
- Read Articles Carefully Prior to Discussion
- What's the Question, the Approach, the Results, the Conclusions?
- Study Each Figure/Experiment/Legends-Ask The Same Questions!
- Read Relevant Parts of Text That Relate to Concepts Covered in Articles
- Read Articles ACTIVELY -Look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



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Plants of Tomorrow