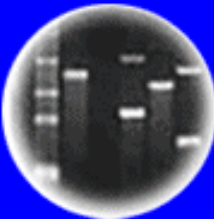


DNA  
Genetic Code of Life



Entire Genetic Code  
of a Bacteria



DNA Fingerprinting



Cloning: Ethical Issues  
and Future Consequences



Plants of Tomorrow

# HC70A & SAS70A Winter 2013 Genetic Engineering in Medicine, Agriculture, and Law

Professors Bob Goldberg, Channapatna  
Prakash & John Harada

## Lecture 9

### Science & The Constitution: Regulating Science & Genetic Engineering

**UCLA**



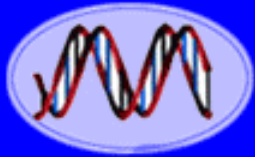
**UC DAVIS**  
UNIVERSITY OF CALIFORNIA

# TEXT READING

Chapters 12 & 13

## SELECTED REFERENCES

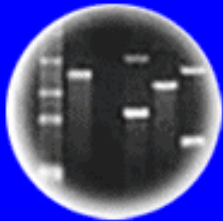
1. *Cloning & The Constitution*, By I.H. Carmen (1985)
2. *A Practical Companion To The Constitution*, By J.K. Lieberman (1999)
3. *The Recombinant DNA Controversy: A Memoir*, By D. S. Fredrickson (2001)
4. *Genetics: Ethics, Law, and Policy*, By Lori B. Andrews et al. (2002)
5. *Stem Cell Century*, By Russell Korobkin (2007)
6. *Biotechnology and The Law*, By H.B. Wellons et al. (2007)
7. *A Guide to Biotechnology Law & Business*, By Robert A. Bohrer (2007)
8. *The Role of Science in The Law*, By Robin Feldman (2009)
9. *Patent, Copyright, & Trademark*, By R. Stim (2010)
10. *Patents in Genomics and Human Genetics*, By Robert Cook-Deegan & Christopher Heaney, *Annu. Rev. Human Genetics*, 11, 383-425 (2010)



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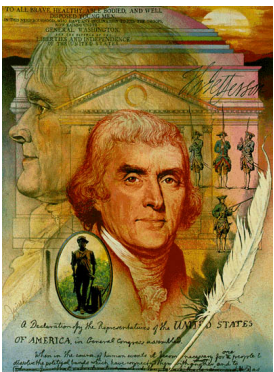
Plants of Tomorrow

## THEMES

1. History of Genetics & Law in the US
2. Inborn Errors & Eugenics
3. Evolution and the Law
4. Historical Attempts to Regulate Science-The Genetic Engineering & Stem Cell Controversies
5. Examples of Regulating Science at the Federal and State Levels
6. Patenting Your Genes
7. Government of the United States
8. What is in the Constitution About Science-Directly & Indirectly?
9. Can Scientific Inquiry and Research Be Regulated?
10. Can Experimentation Be Regulated Directly?
11. Case Studies in Regulating Science Directly
12. Can Science Be Regulated Indirectly?
13. Regulating Science-A Summary

“Laws and institutions must go hand in hand with the progress of the human mind. As that becomes more developed, more enlightened, as new discoveries are made, new truths disclosed, and manners and opinions change with the change of circumstances, institutions must advance also, and keep pace with the times.”

Thomas Jefferson, July 12, 1810

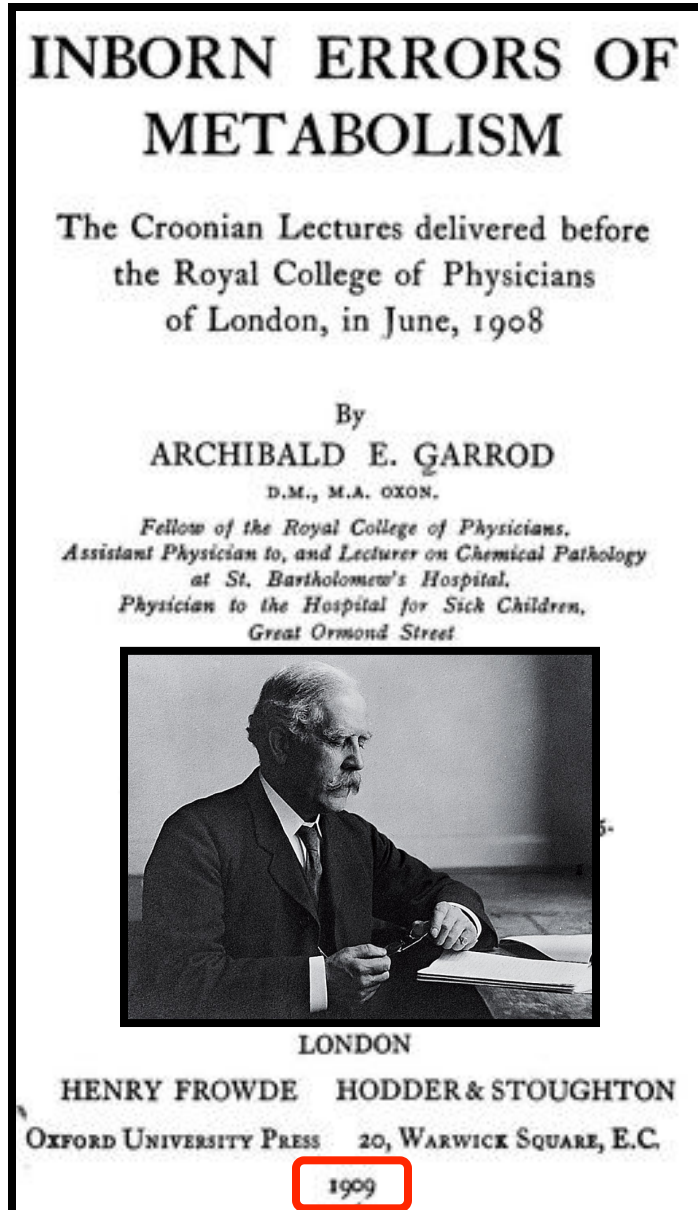




## What is the History of The Relationship Between Genetics & the Law in the United States?



# Garrod Discovered That Some Human Metabolic Diseases Have a Genetic Basis And Follow Mendelian Rules of Inheritance

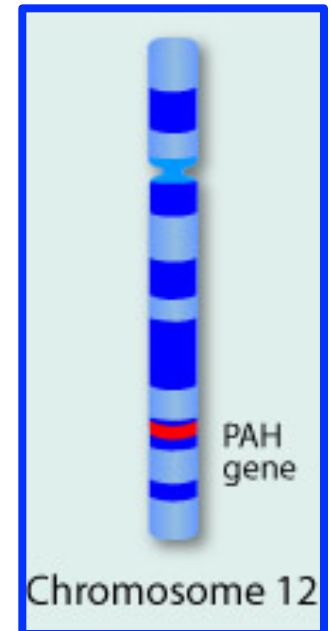
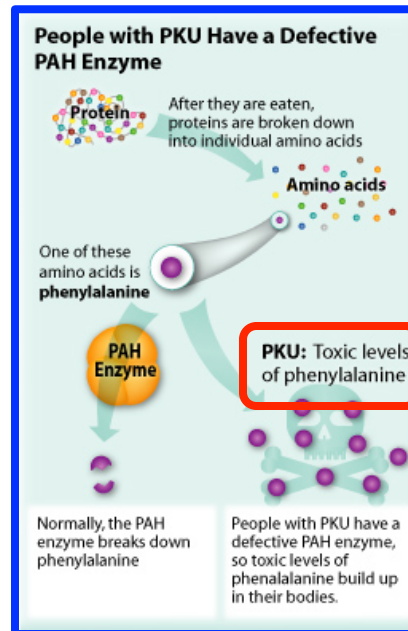
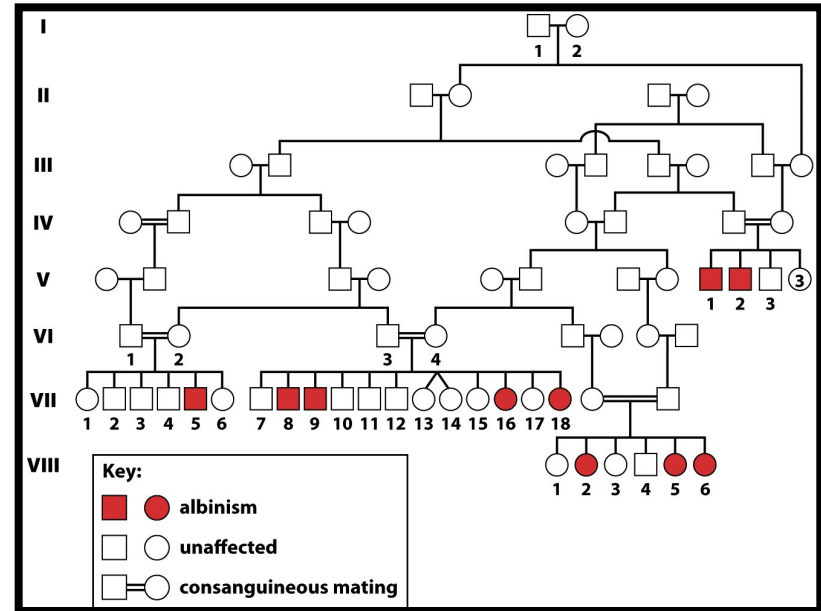
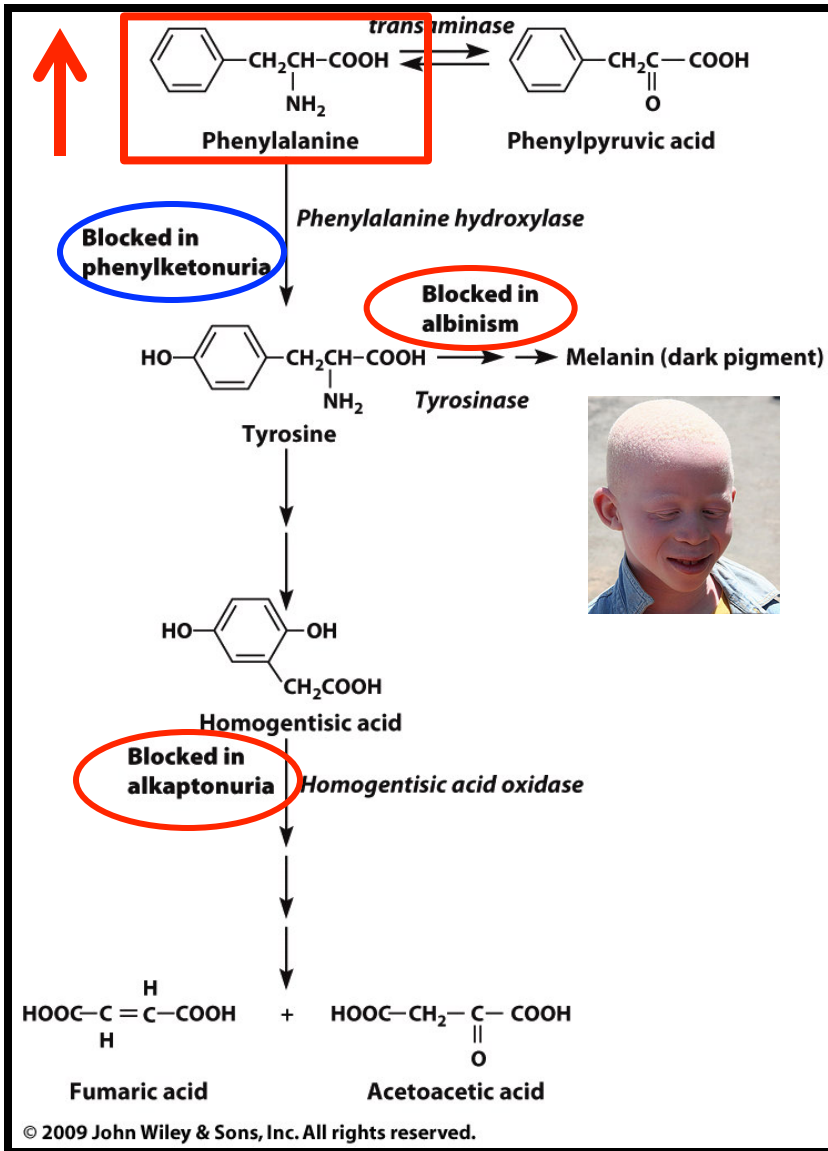


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It appears to me that the strongest argument which can be adduced in favour of this view that alkaptonuria is a Mendelian recessive character is afforded by the fact that albinism, which so closely resembles it in its mode of incidence in man, behaves as a recessive character in the experimental breeding of animals.<sup>32</sup> Nor do the figures quoted by Bateson<sup>30</sup> relating to the proportion of albino members in human families show any more close conformity to the requirements of Mendel's law than do those above quoted for alkaptonuric families.

# Inborn Errors of Metabolism - Defects in Phenylalanine Breakdown

*Dominant or Recessive?*







# PHENYLKETONURIA



## SYMPTOMS

- Phenylalanine plays a role in the body's production of melanin, the pigment responsible for skin and hair color. Therefore, infants with the condition often have lighter skin, hair, and eyes than brothers or sisters without the disease.
- Delayed mental and social skills
- Head size significantly below normal
- Hyperactivity
- Jerking movements of the arms or legs
- Intellectual disability
- Seizures
- Skin rashes
- Tremors
- Unusual positioning of hands

**PHENYLKETONURIA (PKU)** - Inherited Error In Metabolism

[Toxic levels of Phenylalanine (common protein amino acid) due to inability of body to convert]

Can Cause...

- Mental Retardation
- Convulsions
- Behavior Problems
- Skin Rash
- Musty Body Odor

Babies Are Tested...

Both Formula Fed and Breast Fed

A minimum of 24 hrs after beginning milk.

Retest in 7-10 days to catch earlier false negatives.

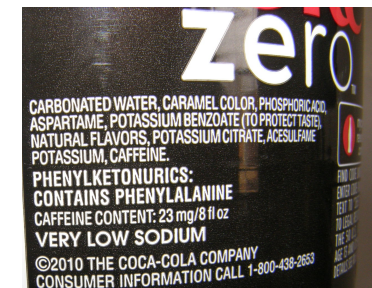
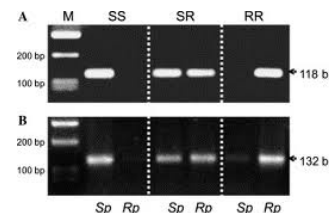
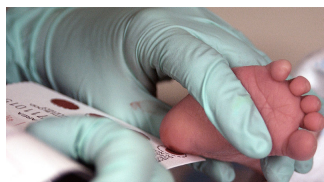
**NO**

- Meat
- Dairy Products
- Dry Beans
- Nuts
- Eggs

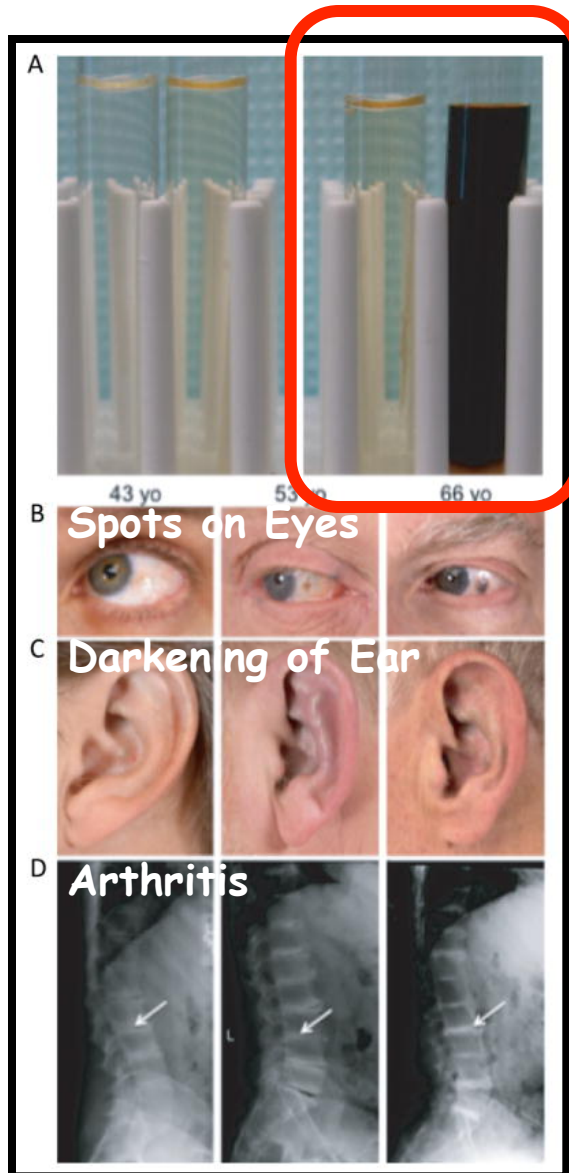
\* Cereals, Fruits & Vegetables in Moderation \*

## TESTS

- PKU can be easily detected with a simple blood test. All states in the US require a PKU screening test for all newborns as part of the newborn screening panel. The test is generally done by taking a few drops of blood from the baby before the baby leaves the hospital.
- DNA Testing



# Inborn Errors in the *Homogentisic Acid Oxidase (HGD)* Gene Leading to Alkaptonuria

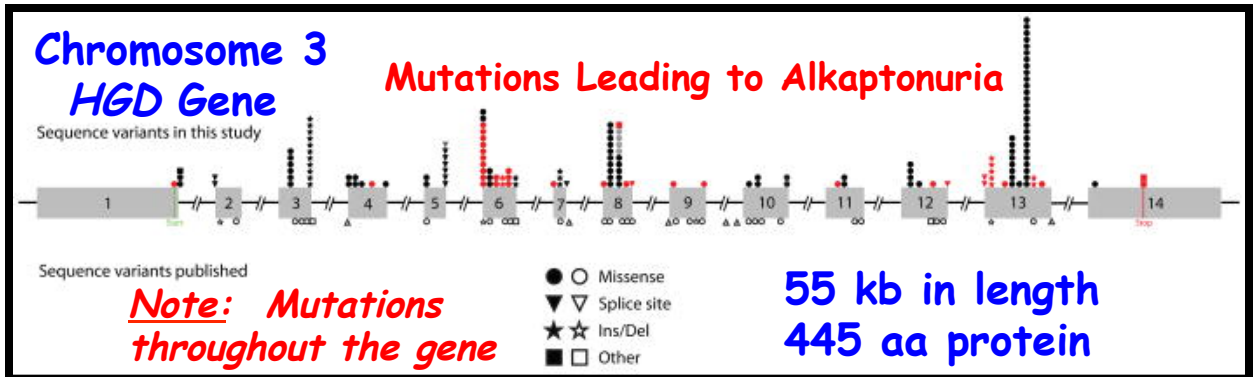


**NATIONAL INSTITUTES OF HEALTH**

**NIH Public Access**  
**Author Manuscript**  
*Hum Mutat.* Author manuscript; available in PMC 2010 December 1.

Published in final edited form as:  
*Hum Mutat.* 2009 December ; 30(12): 1611–1619. doi:10.1002/humu.21120.

**Mutation spectrum of homogentisic acid oxidase (*HGD*) in alkaptonuria**



Summary of identified *HGD* variants

**Note: Different Types of Mutations**

	Missense	Splice site	Indel <sup>a</sup>	Other <sup>b</sup>	Total
<b>NIH Study (Novel)</b>	36 (14)	7 (3)	6 (3)	3 (2)	52 (22)
<b>Other published</b>	26	6	4	3	39
<b>Total</b>	62	13	10	6	91

<sup>a</sup>Indel: includes insertions, deletions and insertion-deletions  
<sup>b</sup>Other: Includes nonsense and no-stop mutations

# How Many Human Disease Genes Have Been Identified?

NCBI OMIM Online Mendelian Inheritance in Man Johns Hopkins University

My NCBI [Sign In] [Register]

All Databases PubMed Nucleotide Protein Genome Structure PMC OMIM

Search OMIM for [Go] [Clear] OMIM, February 19, 2013

Limits Preview/Index History Clipboard Details

Entrez

OMIM

Search OMIM

Search Gene Map

Search Morbid Map

Help

OMIM Help

How to Link

FAQ

Numbering System

Symbols

How to Print

- Enter one or more search terms.
- Use **Limits** to restrict your search by search field, chromosome, and other criteria.
- Use **Index** to browse terms found in OMIM records.
- Use **History** to retrieve records from previous searches, or to combine searches.

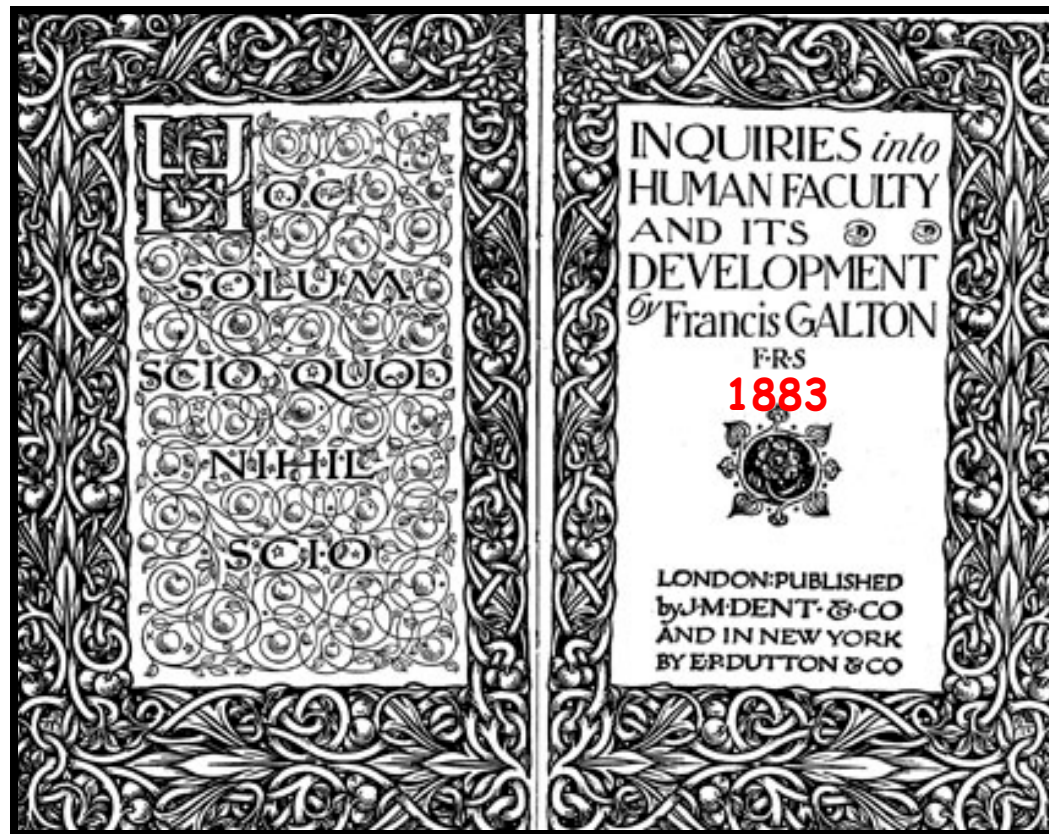
**OMIM® - Online Mendelian Inheritance in Man®**

Welcome to OMIM®, Online Mendelian Inheritance in Man®. OMIM is a comprehensive, authoritative, and timely compendium of human genes and genetic phenotypes. The full-text, referenced overviews in OMIM contain information on all known mendelian disorders and over 12,000 genes. OMIM focuses on the relationship between phenotype and genotype. It is updated daily, and the entries contain copious links to other genetics resources.

1. ~3,413 Human Genes Correlate With a Disease Phenotype
2. The Molecular Basis of These Genetic Diseases Are Known (e.g., Sickle Cell Anemia, Hemophilia A, Tay-Sachs, Cystic Fibrosis, Duchene Muscular Dystrophy, Huntington Disease, etc.)

**Genetic Tests Exist For Many of These Disease Genes -  
But Not in the Early Part of the 20<sup>th</sup> Century!**

## Francis Galton Invented the Term Eugenics



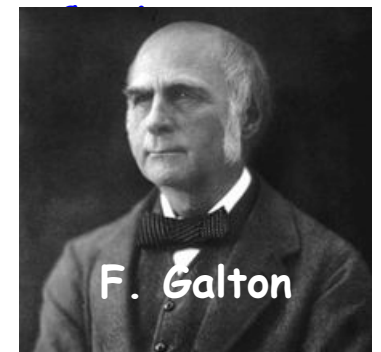
- Regression Line
- Standard Deviation
- Correlation
- Fingerprint Patterns

### EUGENICS

“IS THE STUDY OF THE AGENCIES UNDER SOCIAL CONTROL, THAT IMPROVE OR IMPAIR THE RACIAL QUALITIES OF FUTURE GENERATIONS EITHER PHYSICALLY OR MENTALLY.”

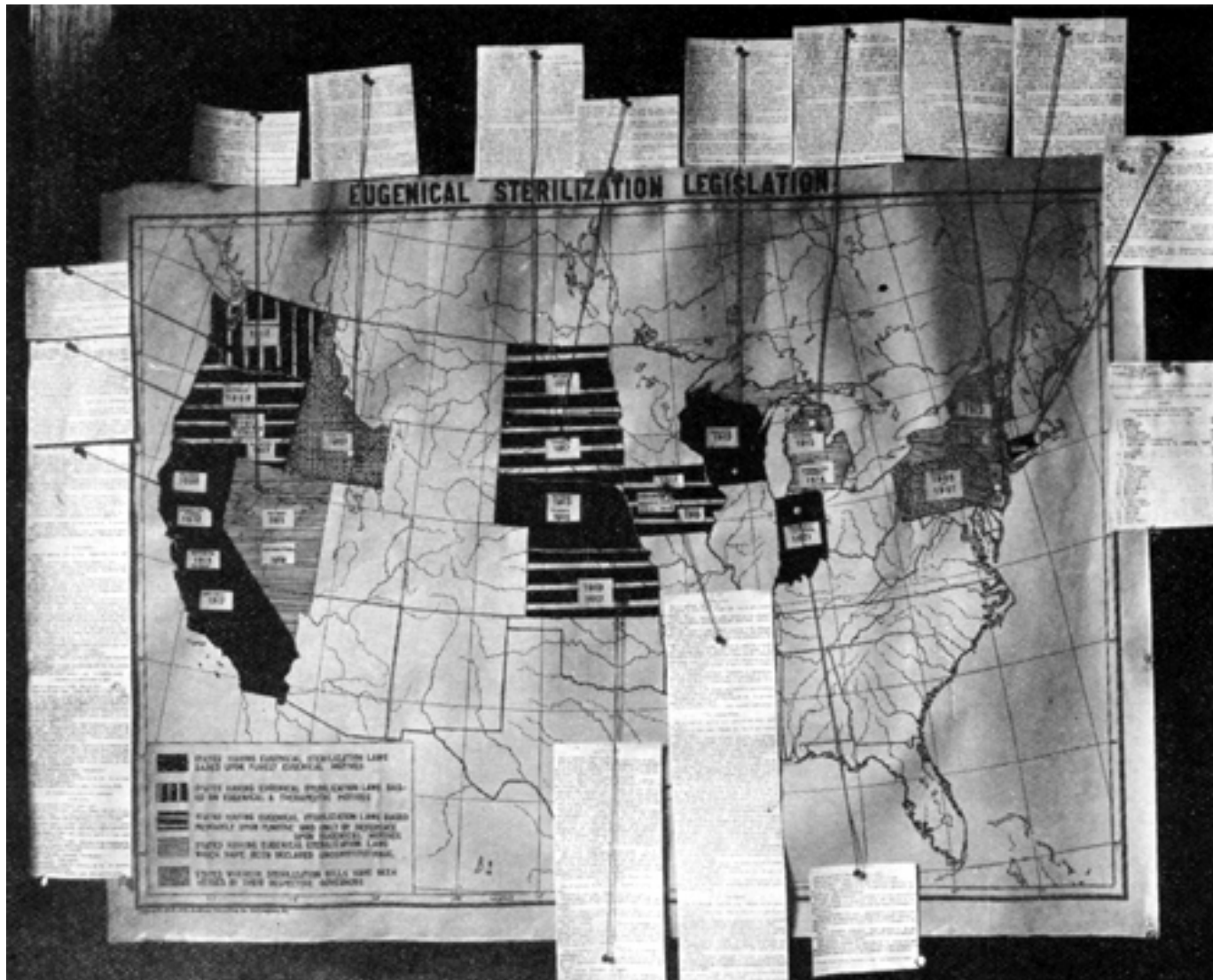
SIR FRANCIS GALTON.

Darwin's Cousin



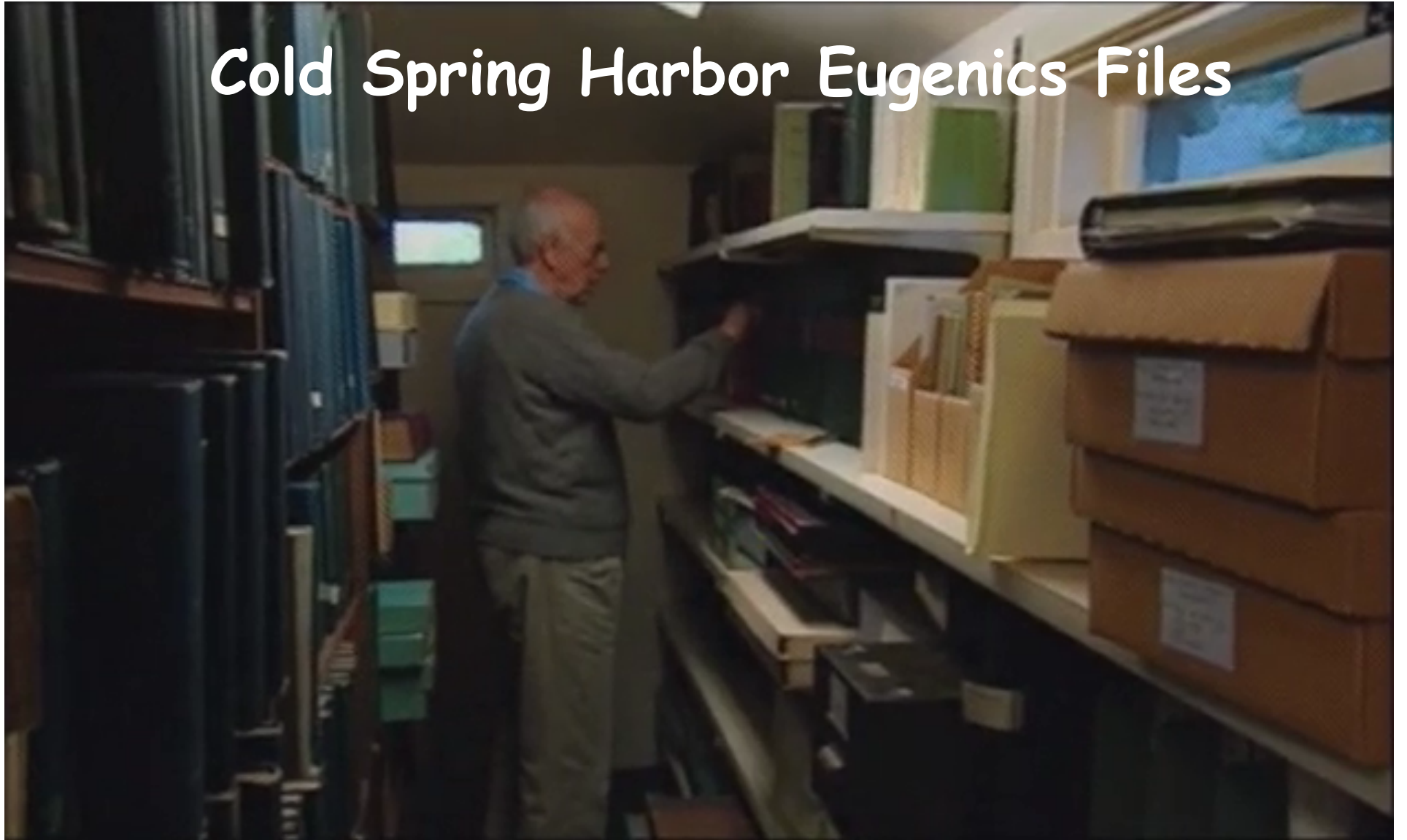
# State Sterilization Laws 1921

*Government Intervention to Promote Biological Improvement of Humans*

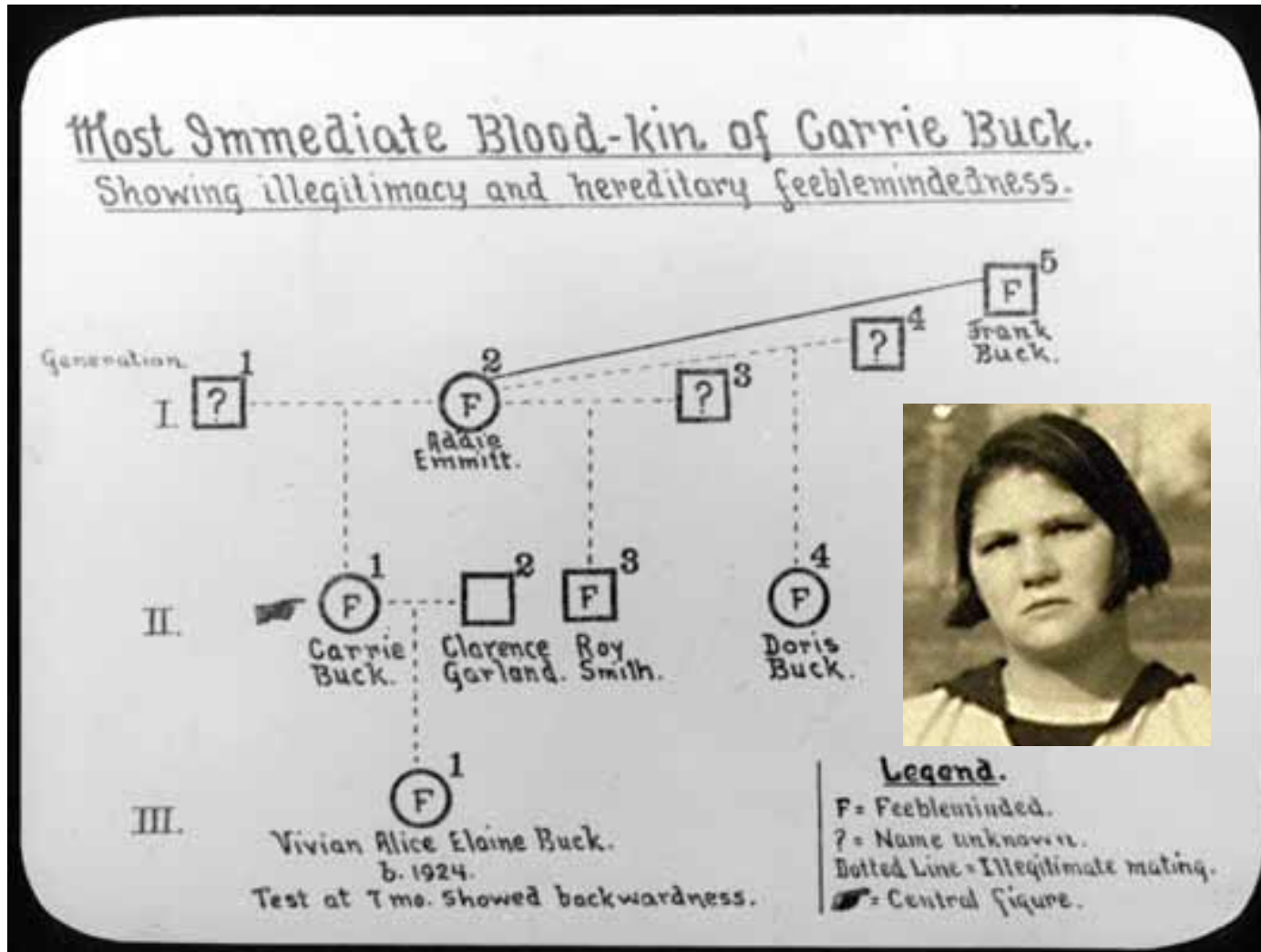


*64,000 Forced Sterilizations in US - Last one in Oregon in 1981  
(Tubal Ligations & Vasectomies)*

# Cold Spring Harbor Eugenics Files



# One of the Most Famous Sterilization Cases in US Legal History Carrie Buck (Buck vs. Bell)



*State of Virginia Colony For Epileptics & Feeble-minded- 1924*



Q

28

# BUCK v. BELL

In 1924, Virginia, like a majority of states then, enacted eugenic sterilization laws. Virginia's law allowed state institutions to operate on individuals to prevent the conception of what were believed to be "genetically inferior" children. Charlottesville native Carrie Buck (1906-1983), involuntarily committed to a state facility near Lynchburg, was chosen as the first person to be sterilized under the new law. The U.S. Supreme Court, in *Buck v. Bell*, on 2 May 1927, affirmed the Virginia law. After Buck more than 8,000 other Virginians were sterilized before the most relevant parts of the act were repealed in 1974. Later evidence eventually showed that Buck and many others had no "hereditary defects." She is buried south of here.

DEPARTMENT OF HISTORIC RESOURCES, 2002



# BUCK v. BELL

The ruling was written by **Justice Oliver Wendell Holmes**. In support of his argument that the interest of the states in a "pure" gene pool outweighed the interest of individuals in their bodily integrity, he argued in 1927:

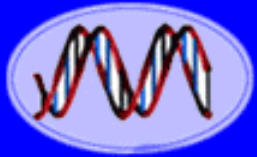
“We have seen more than once that the public welfare may call upon the best citizens for their lives. It would be strange if it could not call upon those who already sap the strength of the State for these lesser sacrifices, often not felt to be such by those concerned, in order to prevent our being swamped with incompetence. It is better for all the world, if instead of waiting to execute degenerate offspring for crime, or to let them starve for their imbecility, society can prevent those who are manifestly unfit from continuing their kind. *The principle that sustains compulsory vaccination is broad enough to cover cutting the Fallopian tubes.*”

Holmes concluded his argument with the infamous phrase *“Three generations of imbeciles are enough.”*

# Anderson 360 on Forced Sterilization Laws



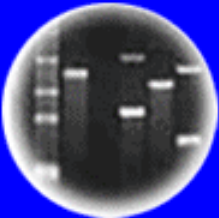
[MOXNEWS.COM](http://MOXNEWS.COM)



DNA  
Genetic Code of Life



Entire Genetic Code  
of a Bacteria



DNA Fingerprinting



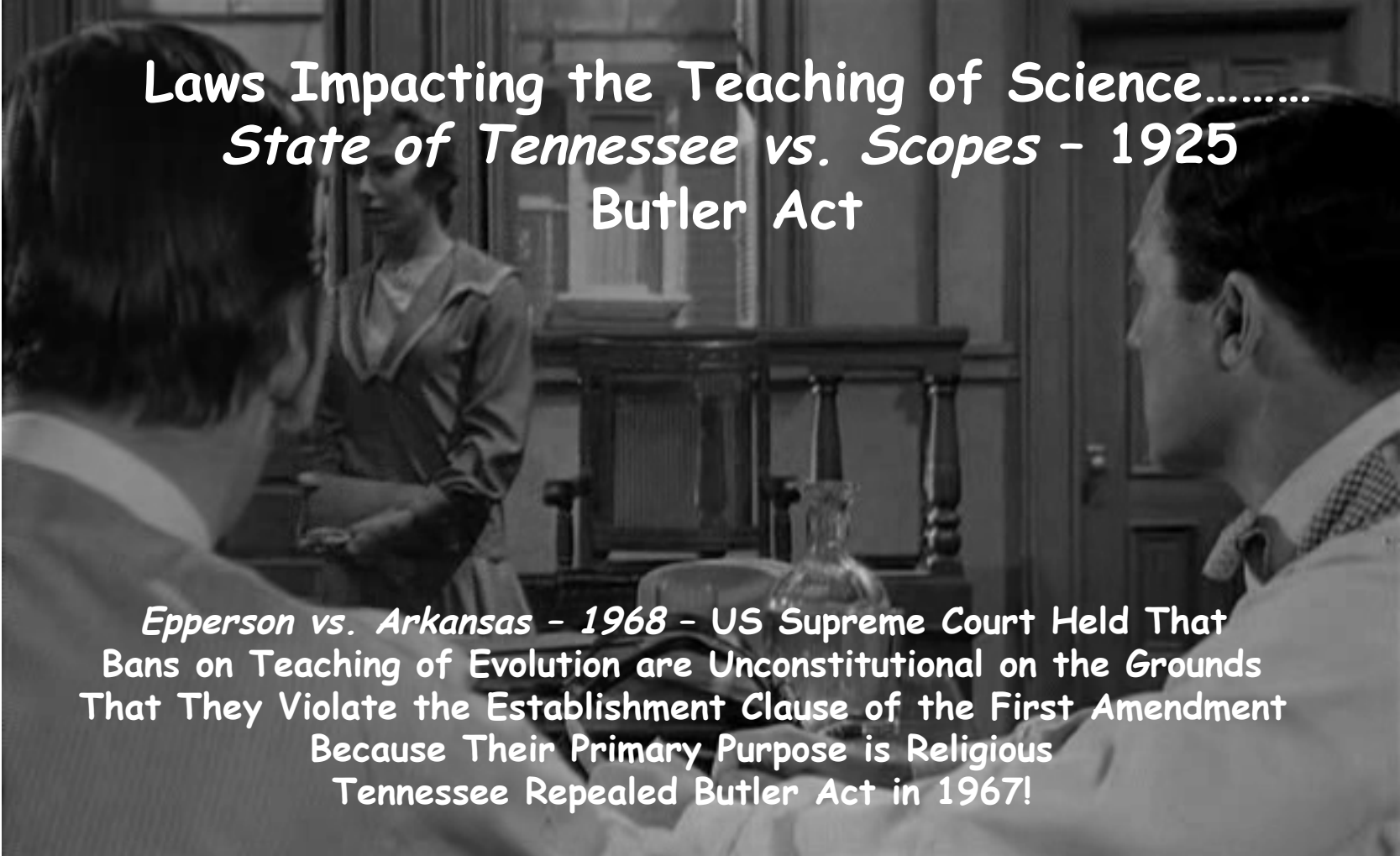
Cloning: Ethical Issues  
and Future Consequences



Plants of Tomorrow

# Laws Impacting the Teaching of Science.....





Laws Impacting the Teaching of Science.....  
*State of Tennessee vs. Scopes - 1925*  
Butler Act

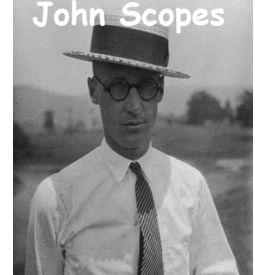
*Epperson vs. Arkansas - 1968 - US Supreme Court Held That  
Bans on Teaching of Evolution are Unconstitutional on the Grounds  
That They Violate the Establishment Clause of the First Amendment  
Because Their Primary Purpose is Religious  
Tennessee Repealed Butler Act in 1967!*

## The Scopes Strategy: Creationists Try New Tactics to Promote Anti-Evolutionary Teaching in Public Schools

Under the guise of "academic freedom" creationists are co-opting some old heroes of the fight to teach evolution in the classroom for their anti-science campaign

By Lauri Lebo | Monday, February 28, 2011 | 23

John Scopes



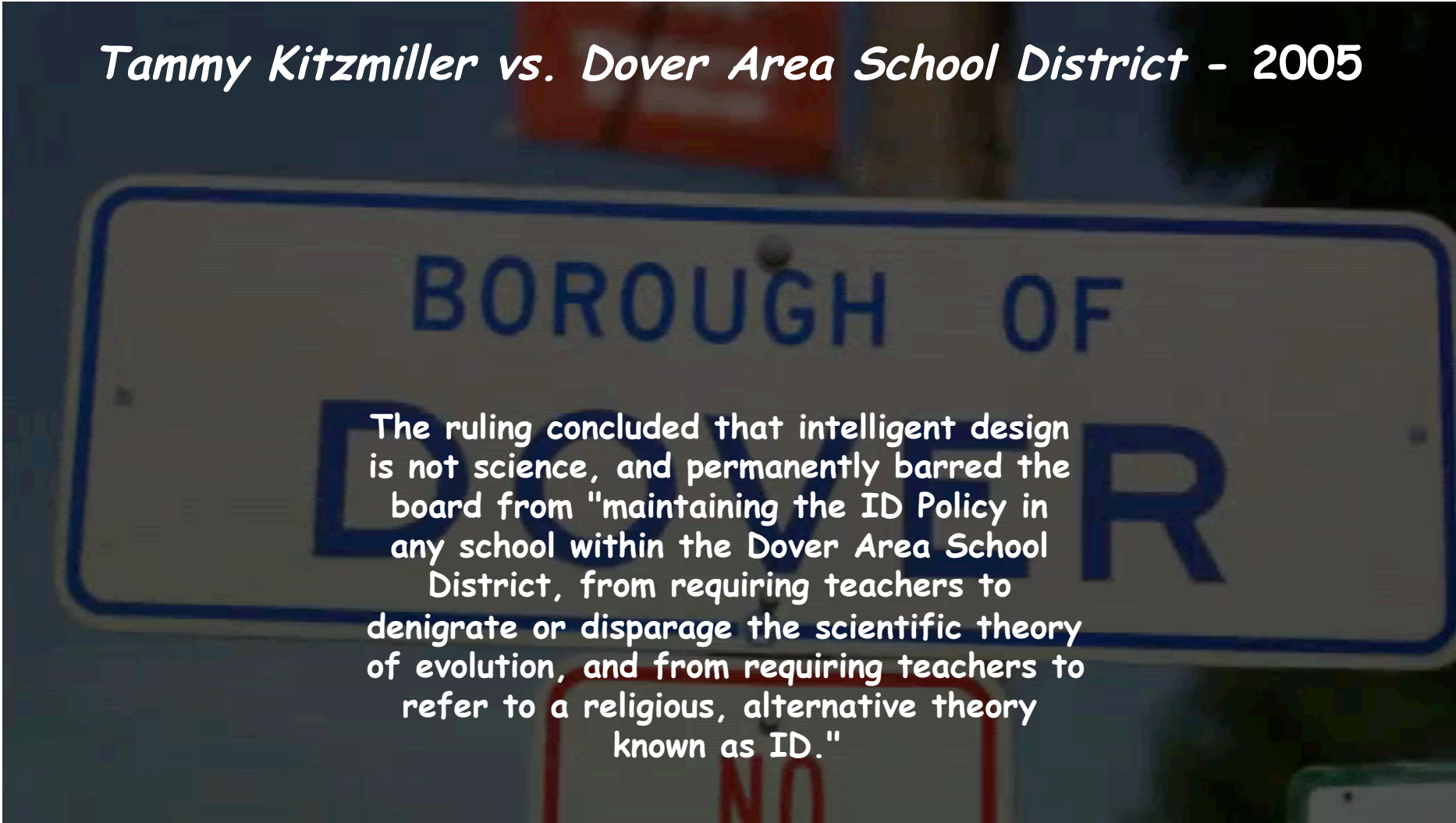
# Ten Major Court Cases about Evolution and Creationism

1. In 1968, in *Epperson v. Arkansas*, the United States Supreme Court invalidated an Arkansas statute that prohibited the teaching of evolution. The Court held the statute unconstitutional on the grounds that the First Amendment to the U.S. Constitution does not permit a state to require that teaching and learning must be tailored to the principles or prohibitions of any particular religious sect or doctrine. (*Epperson v. Arkansas* (1968) 393 U.S. 97, 37 U.S. Law Week 4017, 89 S. Ct. 266, 21 L. Ed 228)

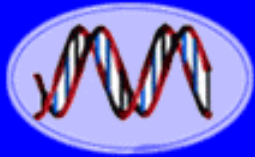
4. In 1987, in *Edwards v. Aguillard*, the U.S. Supreme Court held unconstitutional Louisiana's "Creationism Act". This statute prohibited the teaching of evolution in public schools, except when it was accompanied by instruction in "creation science". The Court found that, by advancing the religious belief that a supernatural being created humankind, which is embraced by the term creation science, the act impermissibly endorses religion. In addition, the Court found that the provision of a comprehensive science education is undermined when it is forbidden to teach evolution except when creation science is also taught. (*Edwards v. Aguillard* (1987) 482 U.S. 578)

10. On December 20, 2005, in *Kitzmiller et al. v. Dover*, U.S. District Court Judge John E. Jones III ordered the Dover Area School Board to refrain from maintaining an Intelligent Design Policy in any school within the Dover Area School District. The ID policy included a statement in the science curriculum that "students will be made aware of gaps/problems in Darwin's Theory and other theories of evolution including, but not limited to, intelligent design." Teachers were also required to announce to their biology classes that "Intelligent Design is an explanation of the origin of life that differs from Darwin's view. The reference book *Of Pandas and People* is available for students to see if they would like to explore this view in an effort to gain an understanding of what Intelligent Design actually involves. As is true with any theory, students are encouraged to keep an open mind". In his 139-page ruling, Judge Jones wrote it was "abundantly clear that the Board's ID Policy violates the Establishment Clause". Furthermore, Judge Jones ruled that "ID cannot uncouple itself from its creationist, and thus religious, antecedents". In reference to whether Intelligent Design is science Judge Jones wrote ID "is not science and cannot be adjudged a valid, accepted scientific theory as it has failed to publish in peer-reviewed journals, engage in research and testing, and gain acceptance in the scientific community". This was the first challenge to the constitutionality of teaching "intelligent design" in the public school science classroom. (*Tammy Kitzmiller, et al. v. Dover Area School District, et al.*, Case No. 04cv2688)

*Tammy Kitzmiller vs. Dover Area School District - 2005*

A photograph of a street sign for the Borough of Dover. The sign is white with a blue border and the words "BOROUGH OF DOVER" in blue capital letters. Overlaid on the sign is a white text box containing the following text: "The ruling concluded that intelligent design is not science, and permanently barred the board from 'maintaining the ID Policy in any school within the Dover Area School District, from requiring teachers to denigrate or disparage the scientific theory of evolution, and from requiring teachers to refer to a religious, alternative theory known as ID.'" The background of the image is dark and blurry, showing other signs and buildings.

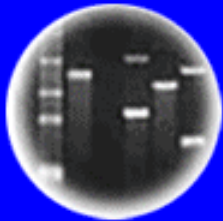
The ruling concluded that intelligent design is not science, and permanently barred the board from "maintaining the ID Policy in any school within the Dover Area School District, from requiring teachers to denigrate or disparage the scientific theory of evolution, and from requiring teachers to refer to a religious, alternative theory known as ID."



DNA  
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Entire Genetic Code  
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DNA Fingerprinting



Cloning: Ethical Issues  
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Plants of Tomorrow

# Attempts to Regulate Genetic Engineering at the Local, State, & Federal Levels

## The Genetic Engineering Controversy: 1974-1986

*The Recombinant DNA Controversy: A Memoir*, By D.S. Fredrickson (2001)

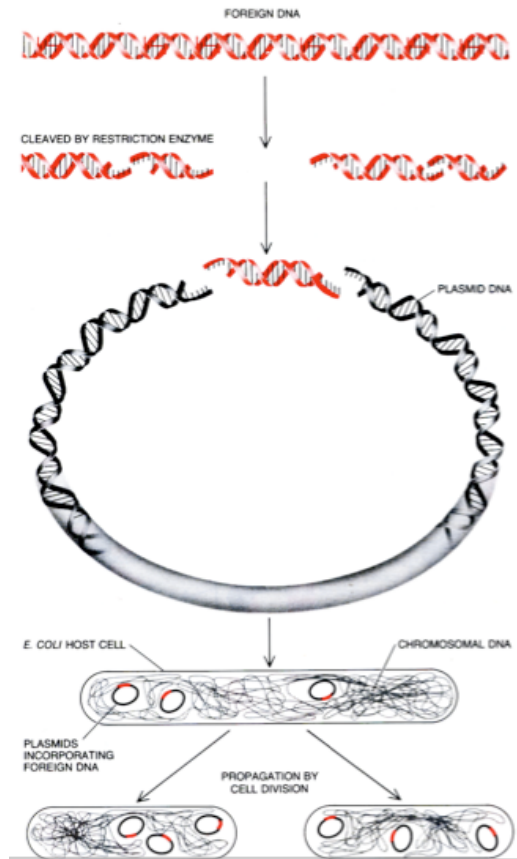
# The Recombinant-DNA Debate

*The four-year-old controversy over the potential biohazards presented by the gene-splicing method and the effectiveness of plans for their containment is viewed in a broader context*

by Clifford Grobstein

**Berg Letter (1974), Asilomar (1975), NIH Guidelines & Recombinant DNA Advisory Committee (RAC) (1976)**

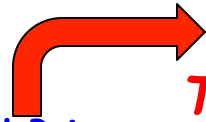
## Cohen-Boyer-1973



		BIOLOGICAL CONTAINMENT (FOR E. COLI HOST SYSTEMS ONLY)		
		EK1	EK2	EK3
PHYSICAL CONTAINMENT	P1	DNA from nonpathogenic prokaryotes that naturally exchange genes with <i>E. coli</i>  Plasmid or bacteriophage DNA from host cells that naturally exchange genes with <i>E. coli</i> . (If plasmid or bacteriophage genome contains harmful genes or if DNA segment is less than 99 percent pure and characterized, higher levels of containment are required.)		
	P2	DNA from embryonic or germ-line cells of cold-blooded vertebrates  DNA from other cold-blooded animals and lower eukaryotes (except insects maintained in the laboratory for fewer than 10 generations)  DNA from plants (except plants containing known pathogens or producing known toxins)  DNA from low-risk pathogenic prokaryotes that naturally exchange genes with <i>E. coli</i>  Organelle DNA from nonprimate eukaryotes. (For organelle DNA that is less than 99 percent pure higher levels of containment are required.)	DNA from nonembryonic cold-blooded vertebrates  DNA from moderate-risk pathogenic prokaryotes that naturally exchange genes with <i>E. coli</i>  DNA from nonpathogenic prokaryotes that do not naturally exchange genes with <i>E. coli</i>  DNA from plant viruses  Organelle DNA from primates. (For organelle DNA that is less than 99 percent pure higher levels of containment are required.)  Plasmid or bacteriophage DNA from host cells that do not naturally exchange genes with <i>E. coli</i> . (If there is a risk that recombinant will increase pathogenicity or ecological potential of host, higher levels of containment are required.)	
	P3	DNA from nonpathogenic prokaryotes that do not naturally exchange genes with <i>E. coli</i>  DNA from plant viruses  Plasmid or bacteriophage DNA from host cells that do not naturally exchange genes with <i>E. coli</i> . (If there is a risk that recombinant will increase pathogenicity or ecological potential of host, higher levels of containment are required.).	DNA from embryonic primate-tissue or germ-line cells  DNA from other mammalian cells  DNA from birds  DNA from embryonic, nonembryonic or germ-line vertebrate cells (if vertebrate produces a toxin)  DNA from moderate-risk pathogenic prokaryotes that do not naturally exchange genes with <i>E. coli</i>  DNA from animal viruses (if cloned DNA does not contain harmful genes)	DNA from nonembryonic primate tissue  DNA from animal viruses (if cloned DNA contains harmful genes)
	P4		DNA from nonembryonic primate tissue  DNA from animal viruses (if cloned DNA contains harmful genes)	



Nobel Prize  
For  
Inventing  
Genetic  
Engineering



# The Berg Letter: Science, July, 1974

## The Catalyst For the Asilomar Conference & NIH Recombinant DNA Guidelines

### Potential Biohazards of Recombinant DNA Molecules

Paul Berg; David Baltimore; Herbert W. Boyer; Stanley N. Cohen; Ronald W. Davis;  
David S. Hogness; Daniel Nathans; Richard Roblin; James D. Watson; Sherman  
Weissman; Norton D. Zinder

*Science*, New Series, Vol. 185, No. 4148 (Jul. 26, 1974), 303.

#### LETTERS

##### **Potential Biohazards of Recombinant DNA Molecules**

Recent advances in techniques for the isolation and rejoining of segments of DNA now permit construction of biologically active recombinant DNA molecules in vitro. For example, DNA restriction endonucleases, which generate DNA fragments containing cohesive ends especially suitable for rejoining, have been used to create new types of biologically functional bacterial plasmids carrying antibiotic resistance markers (1) and to link *Xenopus laevis* ribosomal DNA to DNA from a bacterial plasmid. This latter recombinant plasmid has been shown to replicate stably in *Escherichia coli* where it synthesizes RNA that is complementary to *X. laevis* ribosomal DNA (2). Similarly, segments of *Drosophila* chromosomal DNA have been incorporated into both plasmid and bacteriophage DNA's to yield hybrid molecules that can infect and replicate in *E. coli* (3).

The above recommendations are made with the realization (i) that our concern is based on judgments of potential rather than demonstrated risk since there are few available experimental data on the hazards of such DNA molecules and (ii) that adherence to our major recommendations will entail postponement or possibly abandonment of certain types of scientifically worthwhile experiments. Moreover, we are aware of many theoretical and practical difficulties involved in evaluating the human hazards of such recombinant DNA molecules. Nonetheless, our concern for the possible unfortunate consequences of indiscriminate application of these techniques motivates us to urge all scientists working in this area to join us in agreeing not to initiate experiments of types 1 and 2 above until attempts have been made to evaluate the hazards and some resolution of the outstanding questions has been achieved.

# UCLA Biohazard Committee Approvals

## 1978

UNIVERSITY OF CALIFORNIA, LOS ANGELES  
BIOHAZARDS COMMITTEE

### Approval Notice

PRINCIPAL INVESTIGATOR OF MAIN GRANT: Robert B. Goldberg  
TITLE OF MAIN GRANT: Isolation of Seed Storage Protein Genes for the Soybean Plant  
PRINCIPAL INVESTIGATOR OF PROTOCOL: Same as above FUNDING AGENCY: NIH  
DEPARTMENT: Biology CONTRACT OR GRANT NO. (If known): \_\_\_\_\_  
DIVISION: \_\_\_\_\_ DATES FOR WHICH REVIEWED: FROM: 4-1-79 TO: 3-31-80  
TITLE OF PROJECT: Organization and Expression of Seed Storage Protein Genes in Soybean Development DATE FOR RE-SUBMISSION: 2-28-80  
DATE APPROVED: 5-18-78  
ACTUAL STARTING DATE OF PROTOCOL: 4-1-79

The Biohazards Committee has reviewed the proposed use of recombinant DNA molecules in the project identified above and assures that:

The applicable facilities and procedures have been reviewed by the Biohazards Committee and judged to be both adequate and consistent with the requirements of the NIH guidelines.

The Biohazards Committee will monitor the facilities and procedures throughout the duration of the project.

P2-EK1

Date: May 18, 1978

Signature: David D. Post  
Chairman, Biohazards Committee

Original to: National Institutes of Health  
cc to: Director, Office of Contract and Grant Administration  
Principal Investigator ✓

### MEMORANDUM OF UNDERSTANDING AND AGREEMENT

1. As principal investigator I am familiar with the NIH Guidelines for Research Involving Recombinant DNA Molecules (issued June 23, 1976 and published in the Federal Register, July 7, 1976). I agree to abide by their provisions.

Signed Robert B. Goldberg  
Robert B. Goldberg  
Assistant Professor of Biology

2. Experiments which involve recombinant DNA molecules.
  - A. Background. "Organization and Expression of Seed Storage Protein Genes in Soybean Development"

3. An assessment of the levels of physical and biological containment required by the current NIH Guidelines for these experiments.

The formation of hybrids between plant DNA and bacterial plasmids is given a P2-EK1 classification provided that the plant does not harbor a pathogenic agent nor produce a product toxic to other species (NIH Guidelines, III-18). Plant varieties to be used in experiments with plasmid DNAs do not harbor known plant viruses or pathogenic bacteria, nor do they produce any toxic product. As such I assess a P2-EK1 level of containment as appropriate for these experiments.

# Scientists Report Using Bacteria To Produce the Gene for Insulin

5/24/77

## Rat Insulin Genes:

### Construction of Plasmids Containing the Coding Sequences

*Abstract. Recombinant bacterial plasmids have been constructed that contain complementary DNA prepared from rat islets of Langerhans messenger RNA. Three plasmids contain cloned sequences representing the complete coding region of rat proinsulin I, part of the proinsulin I prepeptide, and the untranslated 3' terminal region of the mRNA. A fourth plasmid contains sequences derived from the A chain region of rat proinsulin II.*

AXEL ULLRICH, JOHN SHINE  
JOHN CHIRGWIN, RAYMOND PICTET  
EDMUND TISCHER, WILLIAM J. RUTTER  
HOWARD M. GOODMAN  
*Department of Biochemistry and  
Biophysics, University of California,  
San Francisco, 94143*

SCIENCE, VOL. 196

17 JUNE 1977

## Scientists Fear Bid to Regulate Genetic Studies

By HAROLD M. SCHMECK Jr.

Special to The New York Times

2/20/77

## HARVARD AND TOWN DEBATE GENE STUDY

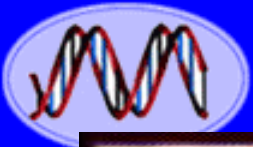
1/17/77

Cambridge Council to Hear a Report  
Urging Tight Controls—Some Fear  
Tests Could Create New Disease

## CALIFORNIA WEIGHING CURBS ON GENE STUDY

2/7/77

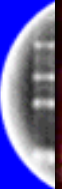
Proposed Safeguards in Research  
on Genetic Hybrids Would Be  
First Imposed by a State



Geneti



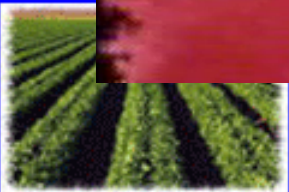
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DNA I



Cloning:  
and Futu



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*Allows P1, P2, & P3 Research Following NIH Guidelines*  
**Special to The New York Times**



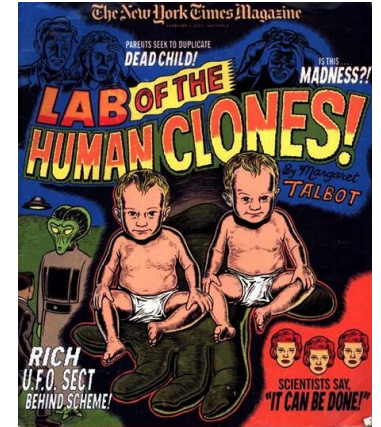
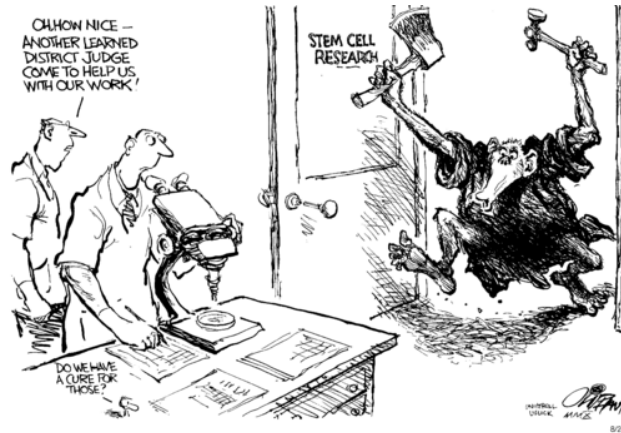
# Attempts to Regulate Human Cloning and Stem Cell Research at the Local, State, & Federal Levels?

## The Stem Cell Funding “Wars” - 1995 to Present

- President Clinton’s NIH Advisory Panel Recommended That Federal Funds Be Used For Research on Human Embryos Discarded From In Vitro Fertilization -1995
- Dickey-Wicker Amendment Prohibited Federal Funding For Research in Which Human Embryos Are Destroyed - 1995
- Human Embryonic Stem Cells Discovered (hESC) -1998
- President Bush Announced That Federal Funds Could Be Used For the First Time on Existing hESC Lines, but Not on Newly Established hESC lines - 2001
- President Bush Vetoes a Bill Passed by Congress Allowing Federal Funding of hESC Research - 2006
- Present Obama Announced That Federal Funds Could Be Used for hESC Research Consistent with the Dickey-Wicker Amendment - 2009
- US District Court Halts Federally Funded hESC research Under Obama Guidelines -2010
- US Appeals Court Allows Federally Funded hESC Research. Upheld by Supreme Court - 2010, 2011, 2012

**Bush vetoes embryonic stem-cell bill**

**Court OKs US-Funded Stem Cell Research for Now**



March 6, 1997

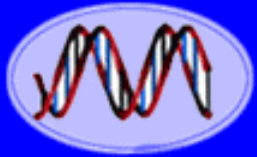
## G.O.P. Lawmaker Proposes Bill to Ban Human Cloning

By KATHARINE Q. SEELYE

**There is No Federal Human Cloning Law.**

**HR2376, 2011 (Pending), Prohibition Against Funding For Human Embryo Reproductive Cloning.**

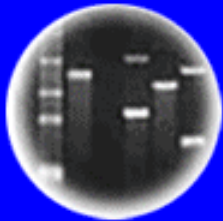
**Fifteen States, Including California, Have Laws Dealing With Human Cloning -- From Banning Both Reproductive and Therapeutic Cloning to only Reproductive Cloning (e.g., California).**



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Genetic Code of Life



Entire Genetic Code  
of a Bacteria



DNA Fingerprinting



Cloning: Ethical Issues  
and Future Consequences

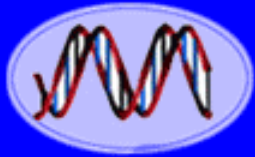


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Should There Be Laws Regulating Science?

- a. Yes
- b. No

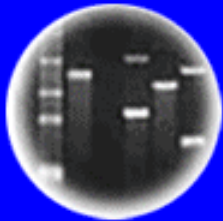




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# Laws Do Exist That Regulate Science at the Federal Level

## Some Examples



genome.gov

National Human Genome Research Institute

National Institutes of Health

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[Research](#)

[Grants](#)

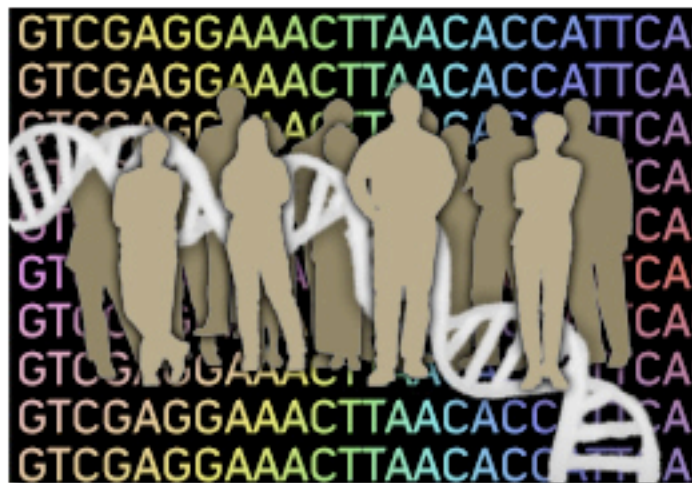
[Health](#)

[Policy  
& Ethics](#)

[Educational  
Resources](#)

[Home](#) > [Educational Resources](#) > [Fact Sheets](#) > **Genetic Discrimination Fact Sheet**

## Genetic Information Nondiscrimination Act of 2008 (GINA)



**Federal Law on Genetic Discrimination**

## Genetic Information Nondiscrimination Act of 2008

### What will GINA do?

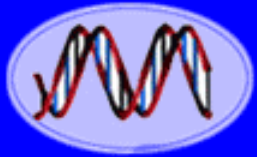
GINA generally will prohibit discrimination in health coverage and employment on the basis of genetic information. GINA, together with already existing nondiscrimination provisions of the Health Insurance Portability and Accountability Act, generally prohibits health insurers or health plan administrators from requesting or requiring genetic information of an individual or the individual's family members, or using it for decisions regarding coverage, rates, or preexisting conditions. The law also prohibits most employers from using genetic information for hiring, firing, or promotion decisions, and for any decisions regarding terms of employment.

The statute defines 'genetic information' as information about:

- an individual's genetic tests (including genetic tests done as part of a research study);
- genetic tests of the individual's family members (defined as dependents and up to and including 4<sup>th</sup> degree relatives);
- genetic tests of any fetus of an individual or family member who is a pregnant woman, and genetic tests of any embryo legally held by an individual or family member utilizing assisted reproductive technology;
- the manifestation of a disease or disorder in family members (family history);
- any request for, or receipt of, genetic services or participation in clinical research that includes genetic services (genetic testing, counseling, or education) by an individual or family member.

Genetic information does not include information about the sex or age of any individual.

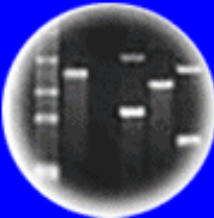
The statute defines 'genetic test' as an analysis of human DNA, RNA, chromosomes, proteins, or metabolites that detects genotypes, mutations, or chromosomal changes. The results of routine tests that do not measure DNA, RNA, or chromosomal changes, such as complete blood counts, cholesterol tests, and liver-function tests, are not protected under GINA. Also, under GINA, genetic tests do not include analyses of proteins or metabolites that are directly related to a manifested disease, disorder, or pathological condition that could reasonably be detected by a health care professional with appropriate training and expertise in the field of medicine involved.



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# DNA Identification Act of 1994

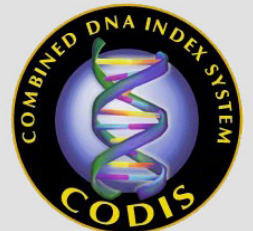
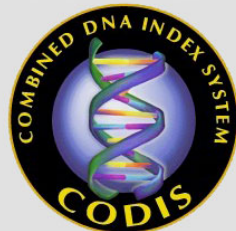
## One Hundred Third Congress of the United States of America

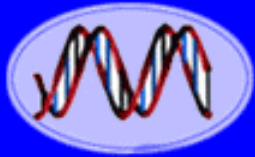
AT THE SECOND SESSION

*Begun and held at the City of Washington on Tuesday,  
the twenty-fifth day of January, one thousand nine hundred and ninety-four*

### Subtitle C—DNA Identification

- Sec. 210301. Short title.
- Sec. 210302. Funding to improve the quality and availability of DNA analyses for law enforcement identification purposes.
- Sec. 210303. Quality assurance and proficiency testing standards.
- Sec. 210304. Index to facilitate law enforcement exchange of DNA identification information.
- Sec. 210305. Federal Bureau of Investigation.
- Sec. 210306. Authorization of appropriations.

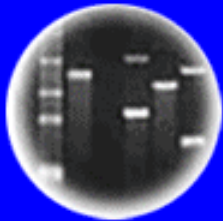




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# Laws Do Exist That Regulate Science at the State Level

## Some Examples

# Laws Exist That Regulate Science at the State Level



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## State Laws on DNA Data Banks Qualifying Offenses, Others Who Must Provide Sample

February 2009

State Laws on  
DNA Data Banks

State	All Felonies	Some Juveniles	Some Misdemeanors	Some Arrestees	Not Guilty By Mental Defect or GBMI	Other
Alabama	X					
Alaska	X	X		X -- Violent felonies.		
Arizona	X	X		X -- Many serious felonies.		Includes residential and criminal burglary.
Arkansas	X	X -- Violent crimes only.	X -- Some sexual offenses.		X	
California	X	X		X -- Expansion to all felon arrestees starts in <u>2009</u> .		Includes those convicted of terrorist activity in violation of weapons of mass destruction provisions; and those convicted of a qualifying offense in another state.



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## California Genetic Laws

- Newborn Genetic Screening
- Genetic Non Discrimination in Insurance
- Human Cloning Laws
- Genetic Employment Laws
- Genetic Counselor Licensing Laws
- Embryonic and Fetal Research Laws
- Embryo and Gamete Disposition Laws
- Genetic Privacy Laws



# National Newborn Screening Status Report

Updated 03/01/10

The U.S. National Screening Status Report lists the status of newborn screening in the United States.

Dot "●" indicates that screening for the condition is universally required by Law or Rule and fully implemented  
**A** = universally offered but not yet required, **B** = offered to select populations, or by request, **C** = testing required but not yet implemented  
**D** = likely to be detected (and reported) as a by-product of MRM screening (MS/MS) targeted by Law or Rule

STATE	Core <sup>1</sup> Conditions										Additional Conditions Included in Screening Panel (universally required unless otherwise indicated)
	Hearing	Endocrine		Hemoglobin			Other				
	HEAR	CH	CAH	Hb S/S	Hb S/A	Hb S/C	BIO	GALT	CF	SCID	
Alabama	●	●	●	●	●	●	●	●	●	●	
Alaska	●	●	●	●	●	●	●	●	●	●	
Arizona	A	●	●	●	●	●	●	●	●	●	
Arkansas	●	●	●	●	●	●	●	●	●	●	
California	B	●	●	●	●	●	●	●	●	●	HHH; PRO; EMA

STATE	Core <sup>1</sup> Conditions - Metabolic																			
	Fatty Acid Disorders					Organic Acid Disorders							Amino Acid Disorders							
	CUD	LCHAD	MCAD	TFP	VLCAD	GA-I	HMG	I/A	3-MCC	Cbl-A,B	BKT	MUT	PROP	MCD	ASA	CIT	HCY	MSUD	PKU	TYR-I
Alabama	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Alaska	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Arizona	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Arkansas	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
California	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

STATE	Secondary Target <sup>1</sup> Conditions																								
	Fatty Acid Disorders							Organic Acid Disorders						Amino Acid Disorders							Other Metabolic		Hbg		
	CACT	CPT-Ia	CPT- II	DE-RED.	GA-II	MCKAT	MUSCHAD	SC AD	2MEHBA	2MBG	3MGA	Cbl-C,D	IBG	MAL	ARG	BIOPT-BS	BIOPT-RG	CIT-II	H-PHE	MET	TYR- II	TYR- III	GALE	GALK	Variant Hbg's
Alabama	●	●	●		●			●	●	●	●					●	●	●	●	●	●			●	
Alaska	●	●	●				●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Arizona	D	D	D		D			D		D	D						D	D		D	D				D
Arkansas																			●						●
California	●	●	●		●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●				●

**Mandatory Screening For >50 Genetic Disorders**



# Mandatory Newborn Screening For Genetic Disorders



Program Overview for California in 2009 Live Birth Statistics					As of: 3/5/2012	
Total	Race			Ethnicity		
	White	Af. American	Am. Indian	Asian/Pacific Is	Hispanic	Non - Hispanic
527,847	419,121	33,608	3,619	71,499	271,031	256,816

California Department of Public Health  
Genetic Disease Screening Program  
Newborn Screening Program  
**Disorders Detectable by NBS Program as of December 15, 2009**

I. Cystic Fibrosis

II. Endocrine Disorders

- primary congenital hypothyroidism
- variant hypothyroidism
- congenital adrenal hyperplasia-salt wasting (21-hydroxylase deficiency)
- congenital adrenal hyperplasia-simple virilizing (21-hydroxylase deficiency)

III. Metabolic Disorders (via tandem mass spectrometry (MS/MS) screening)

A. Amino Acid Disorders

- classical phenylketonuria (PKU)
- variant PKU
- guanidino triphosphate cyclohydrolase 1 (GTPCH) deficiency (bipterin deficiency)
- 5-pyruvyl-tetrahydropterin synthase (PTPS) deficiency (bipterin deficiency)
- dihydropteridine reductase (DHPR) deficiency (bipterin deficiency)
- phenyl-4-carbinolamine dehydratase (PCD) deficiency (bipterin deficiency)
- argininosuccinase deficiency
- argininosuccinic acid lyase deficiency (ASAL deficiency)
- ornithinemia, Type I (argininosuccinic acid synthetase deficiency (ASAS deficiency)
- ornithinemia, Type II (OITN deficiency)
- gyrate atrophy of the choroid and retina
- homocystinuria, hyperornithinemia, hypermethioninemia -HHH
- homocystinuria/cystathionine beta-synthase deficiency (CBS deficiency)
- methionine adenosyltransferase deficiency (MAT deficiency)
- maple syrup urine disease - (MSUD)
- prolidase
- tyrosinemia, Type I, II, III, and transient

B. Organic Acid Disorders

- 2-methyl-3-hydroxybutyryl-CoA dehydrogenase deficiency
- 2-methylbutyryl-CoA dehydrogenase deficiency
- 3-hydroxy-3-methylglutaryl-CoA lyase deficiency (HMGCoA lyase deficiency)
- 3-methylcrotonyl-CoA carboxylase deficiency (MCC deficiency)
- 3-methylglutaconic aciduria (MGA), Type I (3-methylglutaconyl-CoA hydratase deficiency)
- beta-ketothiolase deficiency (BKT)
- ethylmalonic encephalopathy (EE)
- glutamic acidemia type-1 (GA-1)
- isobutyryl-CoA dehydrogenase deficiency
- isovaleric acidemia (IVA)
- malonic aciduria
- methylmalonic acidemia, mut -
- methylmalonic acidemia, mut 0
- methylmalonic acidemia (CM A, B)
- methylmalonic acidemia (CM C, D)
- multiple carboxylase deficiency (MCC)
- propionic acidemia (PA)

C. Fatty Acid Oxidation Disorders

- carnitine transporter deficiency
- carnitine acylcarnitine transferase deficiency (CAT deficiency)
- carnitine palmitoyl transferase deficiency-type 1 (CPT-1 deficiency)
- carnitine palmitoyl transferase deficiency-type 2 (CPT-2 deficiency)
- long chain acyl-CoA dehydrogenase deficiency (LCHAD deficiency)
- medium chain acyl-CoA dehydrogenase deficiency (MCHAD deficiency)
- medium/short chain L-3-hydroxy acyl-CoA dehydrogenase deficiency (M/SCHAD deficiency)
- multiple acyl-CoA dehydrogenase deficiency (MAD deficiency)(glutaric acidemia type-2 (GA-2)
- short chain acyl-CoA dehydrogenase deficiency (SCAD deficiency)
- trifunctional protein deficiency (TFP deficiency)
- very long chain acyl-CoA dehydrogenase deficiency (VLCAD deficiency)

IV. Other Metabolic Disorders

- A. classical galactosemia
- B. biotinidase deficiency

V. Hemoglobin Disorders

- sickle cell anemia (Hb S/S disease)
- sickle C disease (Hb S/C disease)
- sickle D disease (Hb S/D disease)
- sickle E disease (Hb S/E disease)
- Hb S/ I hereditary persistence of fetal hemoglobin (Hb S/HpFH)
- sickle cell disease variant (other sickle cell disease, Hb S/V)
- Hb S/ Beta<sup>+</sup> thalassemia
- Hb S/Beta<sup>+</sup> thalassemia
- Hb C disease (Hb CC)
- Hb D disease (Hb DD)
- alpha thalassemia major
- Hb H disease
- Hb H: Constant Spring disease
- beta thalassemia major
- Hb E/ Beta<sup>+</sup> thalassemia
- Hb E/Beta<sup>+</sup> thalassemia
- Hb E/ Delta/Beta thalassemia
- Hb G/ Beta<sup>+</sup> thalassemia
- Hb C/Beta<sup>+</sup> thalassemia
- Hb D/ Beta<sup>+</sup> thalassemia
- Hb D/Beta<sup>+</sup> thalassemia
- Hb Variant/ Beta<sup>+</sup> thalassemia
- Hb Variant/Beta<sup>+</sup> thalassemia
- other hemoglobinopathies (Hb variants)

Due to biological variability of newborns and differences in detection rates for the various disorders in the newborn period, the Newborn Screening Program will not identify all newborns with these conditions. While a positive screening result identifies newborns at an increased risk to justify a diagnostic work-up, a negative screening result does not rule out the possibility of a disorder. Health care providers should remain watchful for any sign or symptoms of these disorders in their patients. A newborn screening result should not be considered diagnostic, and cannot replace the individualized evaluation and diagnosis of an infant by a well-trained, knowledgeable health care provider.

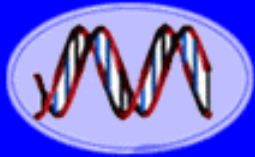


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## California Genetic Privacy Laws

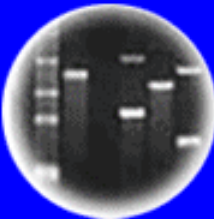
State and Statute	Personal Access to Genetic Information Required	Consent Required to			Disclose Genetic Information	Define as Personal Property		Specific Penalties for Genetic Privacy Violations
		Perform/ Require Genetic Test	Obtain/ Access Genetic Information	Retain Genetic Information		Genetic Information	DNA Samples	
Alabama								
Alaska §18.13.010-100		x	x	x	x	x	x	x
Arizona §20-448.02		x			x			
Arkansas §20-35-101 to 103					x			
California Insurance §10149.1					x			x



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of a Bacteria



**DNA Fingerprinting**



**Cloning: Ethical Issues**  
and Future Consequences



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## California Passes Law Prohibiting Discrimination Based on Genetic Information

POSTED ON **OCTOBER 24, 2011** BY **HUNTON & WILLIAMS LLP**

As reported in the [Hunton Employment & Labor Perspectives Blog](#):

California Governor Jerry Brown recently signed into law Senate Bill No. 559 (SB 559), which prohibits discrimination based on an individual's genetic information. While SB 559 significantly expands the protections from genetic discrimination provided under the federal Genetic Information Nondiscrimination Act of 2008 (GINA), at this time, its impact on most California employers is thought to be limited to the potential for greater damages to be awarded under it than under its federal counterpart.

### What This Means for California Employers

GINA already prohibits discrimination on the basis of genetic information in the areas of employment and health insurance. Title II of GINA, which governs employers, prohibits the use of genetic information in hiring, termination, or making decisions related to compensation, terms, conditions, or privileges of employment. Title II also restricts employers from requesting, requiring, or purchasing genetic information, with certain limited exceptions, and limits the disclosure of genetic information. (A detailed discussion of the U.S. Equal Employment Opportunity Commission's final regulations interpreting Title II of GINA can be found [here](#).) However, GINA's scope is limited to employers who employ 15 or more employees.

SB 559 extends the prohibition on discrimination based on genetic information to employers employing five or more persons. SB 559 also expands on the protections available under the federal law by prohibiting discrimination based on genetic information in the additional areas of housing, mortgage lending, public accommodations, emergency medical services, licensing exams, and programs administered or funded by the state. In the employment context, SB 559 amends the California Fair Employment and Housing Act (FEHA), which already protects the right and opportunity of all persons to seek, obtain and hold employment without discrimination on account of race, religious creed, color, national origin, ancestry, physical disability, mental disability, medical condition, marital status, sex, age, or sexual orientation, to also include genetic information as a prohibited basis for discrimination.



## Genetics and Life, Disability and Long-term Care Insurance

Updated January 2008

## State Laws on Insurance Genetic Discrimination

State and Statutes	Restricts Discrimination Based on Genetic Information in Life Insurance	Restricts Discrimination Based on Genetic Information in Disability Insurance	Restricts Discrimination Based on Genetic Information in Long-term Care Insurance	Requires Actuarial Justification to Use Genetic Information in Life Insurance	Requires Informed Consent to Use Genetic Information
Alabama					
Alaska					
Arizona <a href="#">§20-448</a>	v	v		v	v
Arkansas					
California <a href="#">Insurance §§10146 to 10149.1</a>	v	v	v		v <sup>1</sup>

## Genetics and Health Insurance State Anti-Discrimination Laws

## State Laws on Health Insurance Genetic Discrimination

Updated January 2008

Genetic Information: Legal Issues Relating to Discrimination and Privacy  
 Congressional Research Service, March 2008

The table below provides a current summary of state laws pertaining to the use of genetic information in health insurance. Restrictions on the use of genetic information in health insurance may address the use of genetic information in individual insurance, group insurance or both. These laws may restrict health insurers from engaging in certain activities, including using genetic information to determine eligibility or set premiums, requiring genetic testing of applicants, or disclosing genetic information without consent. The laws listed below do not govern the use of genetic information in employer-sponsored health benefit plans, which are under the purview of the federal government, and certain exceptions may apply. The states with genetics and health insurance laws listed below also may have laws related to other genetics policy issues, such as genetic privacy or genetic discrimination in other settings. The legislature may have addressed these issues in conjunction with or separately from genetics and health insurance.

NCSL members can access further information on this topic in the article "[Plunging into the Gene Pool](#)" from the March 2007 issue of State Legislatures. A series of publicly available GeneticsBriefs also provide background information on the subject.

State	Citation	Type of Insurance Policy	May not Establish Rules for Eligibility based on Genetic Information	May not Require Genetic Tests/Genetic Information	May not Use Genetic Information for Risk Selection or Risk Classification Purposes	May not Disclose Information Without Informed Consent
California	Insurance Code: §§742.405, 7, 10140, 3, 6 to 9, 9.1	Individual and Group	X	X	X	X



## State Laws on Stem Cell Research

## State Laws on Human Cloning

State/Jurisdiction Statute Section	Specifically permits research on fetus/embryo	Restricts research on aborted fetus/embryo	Consent provisions to conduct research on fetus/embryo <sup>3</sup>	Restricts research on fetus or embryo resulting from sources other than abortion	Restrictions of purchase/sale of human tissue for research
Arizona §§26-2302, 2303	No	Yes, prohibits research on aborted living/non-living embryo or fetus	No	Yes, prohibits the use of public monies for cloning for research	No
Arkansas §§20-17-802, 20-16-1001 to 1004	No	Yes, prohibits research on aborted live fetus	Yes, consent to conduct research on aborted fetus born dead	Yes, prohibits research on cloned embryos	Yes, prohibits sale of fetus/fetal tissue
California Health & Safety 2004 Proposition 71 §§ 123440, 24185, 12115-7, 125300-320	Yes, permits research on adult and embryonic stem cells from any source	Yes, prohibits research on aborted live fetus	Yes, consent to donate IVF embryo to research	Prohibits sale of embryos and oocytes; prohibits payment in excess of the amount of reimbursement of expenses to be made to any research subject to encourage her to produce human oocytes for the purposes of medical research	Yes, prohibits sale for the purpose of reproductive cloning or for stem cell research

State	Statute Citation	Summary	Prohibits Reproductive Cloning	Prohibits Therapeutic Cloning	Expiration
Arizona	HB 2221 (2005)	Bans the use of public monies for reproductive or therapeutic cloning.	Prohibits use of public monies	Prohibits use of public monies	
Arkansas	§20-16-1001 to 1004	Prohibits therapeutic and reproductive cloning; may not ship, transfer or receive the product of human cloning; human cloning is punishable as a Class C felony and by a fine of not less than \$250,000 or twice the amount of pecuniary gain that is received by the person or entity, which ever is greater	yes	yes	
California	Business And Professions §16004, Health & Safety §24185, §24187, §24189, §12115-7	Prohibits reproductive cloning; permits cloning for research; provides for the revocation of licenses issued to businesses for violations relating to human cloning; prohibits the purchase or sale of ovum, zygote, embryo, or fetus for the purpose of cloning human beings; establishes civil penalties	yes	no	

Constitutional?

## State Laws on Biotechnology

California	Cal. Food & Agricultural Code §§ 491 to 492 (2007)	<b>State Oversight.</b> Legislative findings that with the burgeoning field of biotechnology comes a need for the public to be informed about the benefits and potential risks of the technology. Establishes the Food Biotechnology Task Force.
California	Cal. Food & Agricultural Code § 2272 (2007)	<b>State Oversight.</b> Allows for the County Agricultural Commissioner to include supplemental information on biotechnology in the annual report on the condition of agriculture.
California	Cal. Food & Agricultural Code § 12798 (2007)	<b>State Funding.</b> Establishes competitive grant programs to fund pest management research, including biotechnological research.
California	Cal. Food & Agricultural Code § 52300 to 52306 (2007)	<b>State Oversight.</b> Legislature to clarify the role and responsibility of the Department of Food and Agriculture in the oversight of regulated agricultural biotechnology.
California	Cal. Food & Agricultural Code § 52100 (2007)	<b>Destruction.</b> Any person who intentionally destroys test or research crop is liable for up to twice the market value of the crops.
California	Cal. Unemployment and Ins. Code § 9700 - 9702 (2007)	<b>State Support.</b> Sets forth legislative findings and declarations that the San Diego biotechnology industry increasingly needs more biotechnology professionals of all levels that are familiar with industry-like conditions for basic, applied, and transitional research, training, and production; states legislative findings that the San Diego Multiuse Biotechnology Training Center is being created to serve as an anchor for the growth of biotechnology enterprise.
California	Cal. Penal Code § 11417 (2002)	<b>Destruction.</b> Considers acts against agricultural biotechnology an act of terrorism.
California	Cal. Fish and Game Code § 15007 (2007)	<b>Regulation.</b> Makes it illegal to spawn, cultivate, or incubate any transgenic fish in the state controlled waters of the Pacific Ocean.

# GloFish Fluorescing With Different Colors!!







# California GMO Bans

<u>Counties</u>	<u>Cities</u>
Mendocino Marin, Santa Cruz Trinity	Arcata Point Arena.

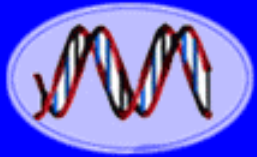
## California GMO Labeling Initiative

What About Federal Preemption?



[www.FactsOn37.com](http://www.FactsOn37.com)

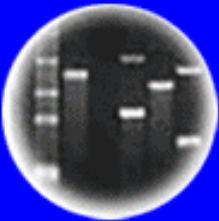




DNA  
Genetic Code of Life



Entire Genetic Code  
of a Bacteria



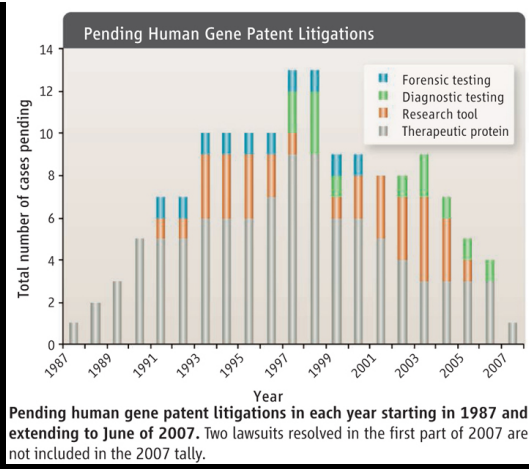
DNA Fingerprinting



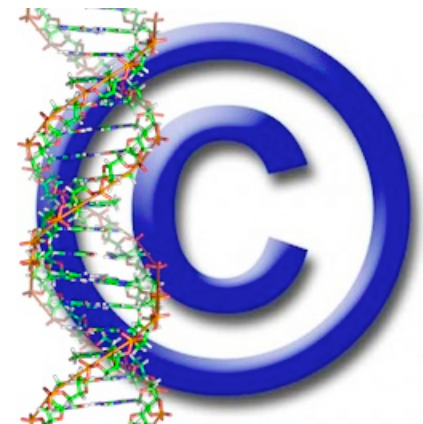
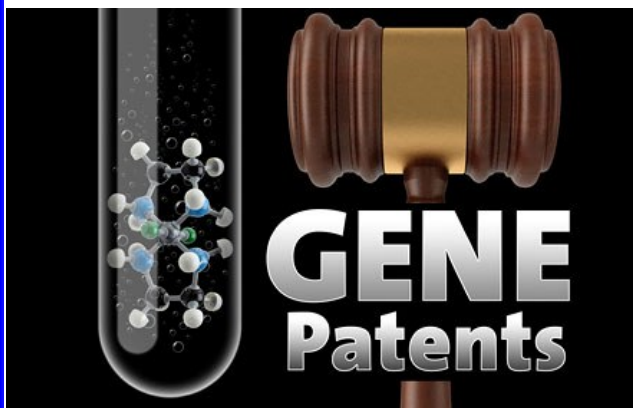
Cloning: Ethical Issues  
and Future Consequences



Plants of Tomorrow



# What About Other Legal Issues and Laws Dealing With Genes and Genetic Engineering?



# Life Is Patentable

(Diamond vs. Chakrabarty)

**SCIENCE MAY PATENT  
NEW FORMS OF LIFE,  
JUSTICES RULE, 5 TO 4**

1980

The Supreme Court rules that Ananda Chakrabarty's bacterium is not a "product of nature" and so can be patented; other living things "made by man" are declared patentable as well



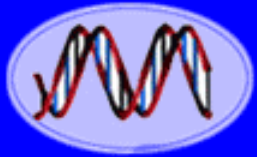
Ananda Chakrabarty



1988

Harvard University gets a patent for the OncoMouse, a rodent with a gene inserted that predisposes it to cancer

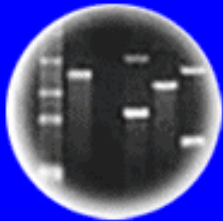
6/17/1980



DNA  
Genetic Code of Life



Entire Genetic Code  
of a Bacteria



DNA Fingerprinting



Cloning: Ethical Issues  
and Future Consequences



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Should Patenting a *Genetically Engineered Mouse*  
Be Permitted?

- a. Yes
- b. No

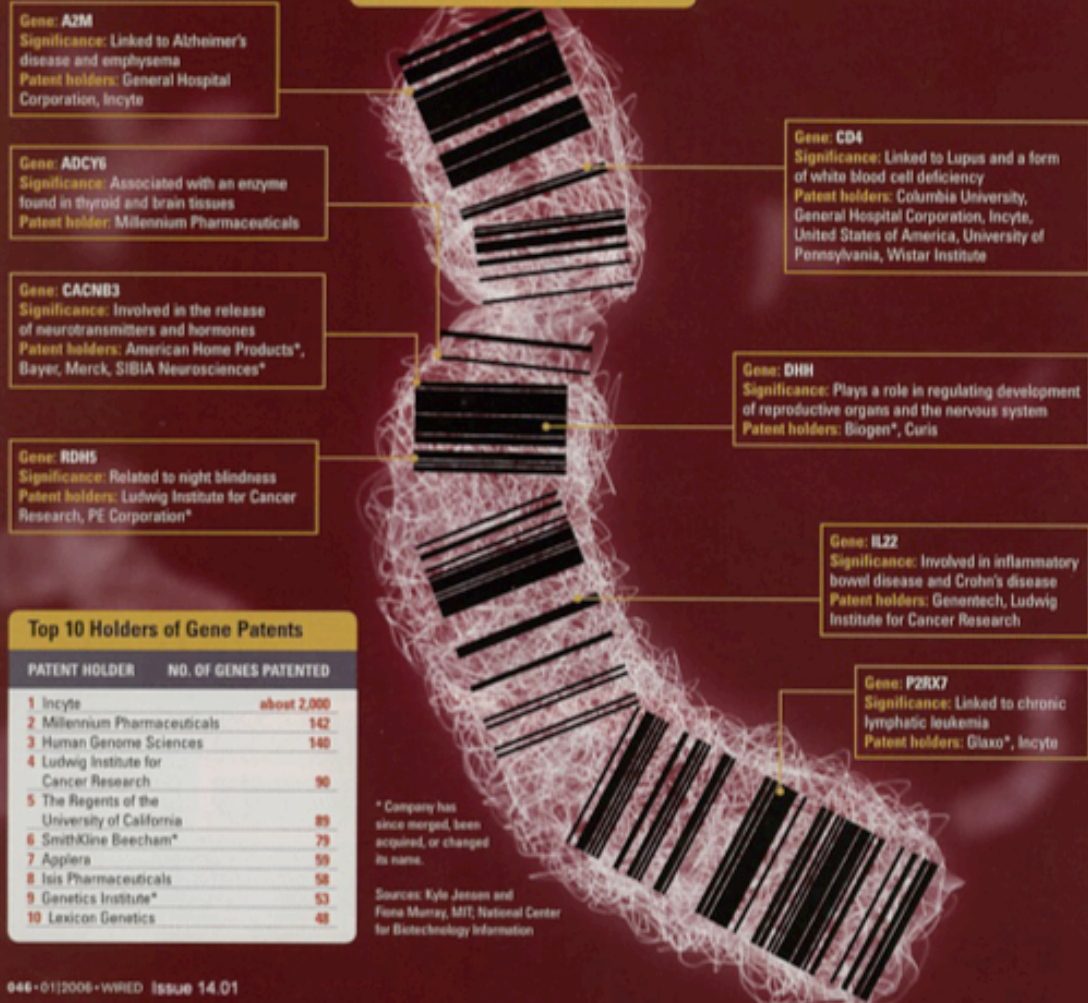
# Everybody Wants a Piece of You

One-fifth of your DNA is now owned (as in patented) by someone else.

You've heard of patenting PC parts, but human parts? Organizations are now patenting sequences of nucleotides so they can license the rights to other companies that use the sequences to develop drugs or diagnostic tests. In a sense, the institutions that hold these patents own the intellectual property rights to you – nearly a fifth of you, in fact. A new study from researchers at MIT shows that 4,270 US patents have been issued for 4,382 individual human genes – almost 20 percent of the entire genome. "Patents appear to be concentrated in areas relevant to human disease and biological pathways," says Fiona Murray, a professor

## A LOOK AT CHROMOSOME 12

374 total patents (sections highlighted in black)

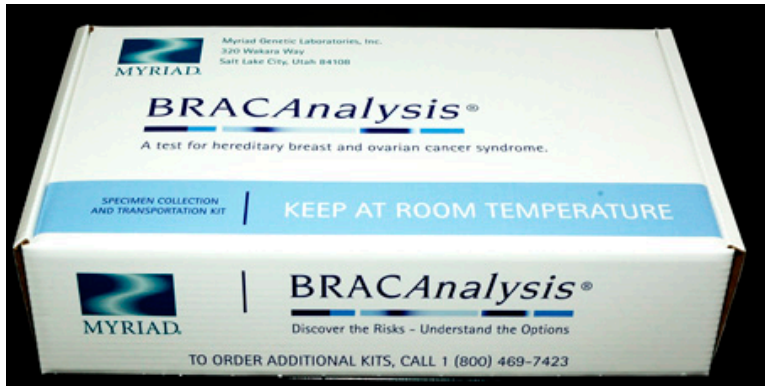


### Top 10 Holders of Gene Patents

PATENT HOLDER	NO. OF GENES PATENTED
1 Incyte	about 2,000
2 Millennium Pharmaceuticals	142
3 Human Genome Sciences	140
4 Ludwig Institute for Cancer Research	90
5 The Regents of the University of California	85
6 SmithKline Beecham*	79
7 Applera	59
8 Isis Pharmaceuticals	58
9 Genetics Institute*	53
10 Lexicon Genetics	48

\* Company has since merged, been acquired, or changed its name.

Sources: Kyle Jensen and Fiona Murray, MIT, National Center for Biotechnology Information



March 29, 2010

## Judge Invalidates Human Gene Patent

By JOHN SCHWARTZ and ANDREW POLLACK

A federal judge on Monday struck down patents on two genes linked to breast and ovarian cancer. The decision, if upheld, could throw into doubt the patents covering thousands of human genes and reshape the law of intellectual property

United States District Court Judge Robert W. Sweet issued the 152-page decision, which invalidated seven patents related to the genes BRCA1 and BRCA2, whose mutations have been associated with cancer.

The American Civil Liberties Union and the Public Patent Foundation at the Benjamin N. Cardozo School of Law in New York joined with individual patients and medical organizations to challenge the patents last May: they argued that genes, products of nature, fall outside of the realm of things that can be patented. The patents, they argued, stifle research and innovation and limit testing options.

November 30, 2012

## Supreme Court to Look at a Gene Issue

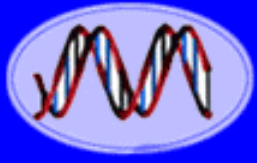
By ADAM LIPTAK

**MYRIAD**  
GENE PATENT LITIGATION



**Rights to Human Gene Patents Go on Trial**

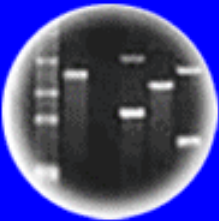
Do patents on breast, ovarian cancer genes, retard new research?



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DNA Fingerprinting



Cloning: Ethical Issues  
and Future Consequences



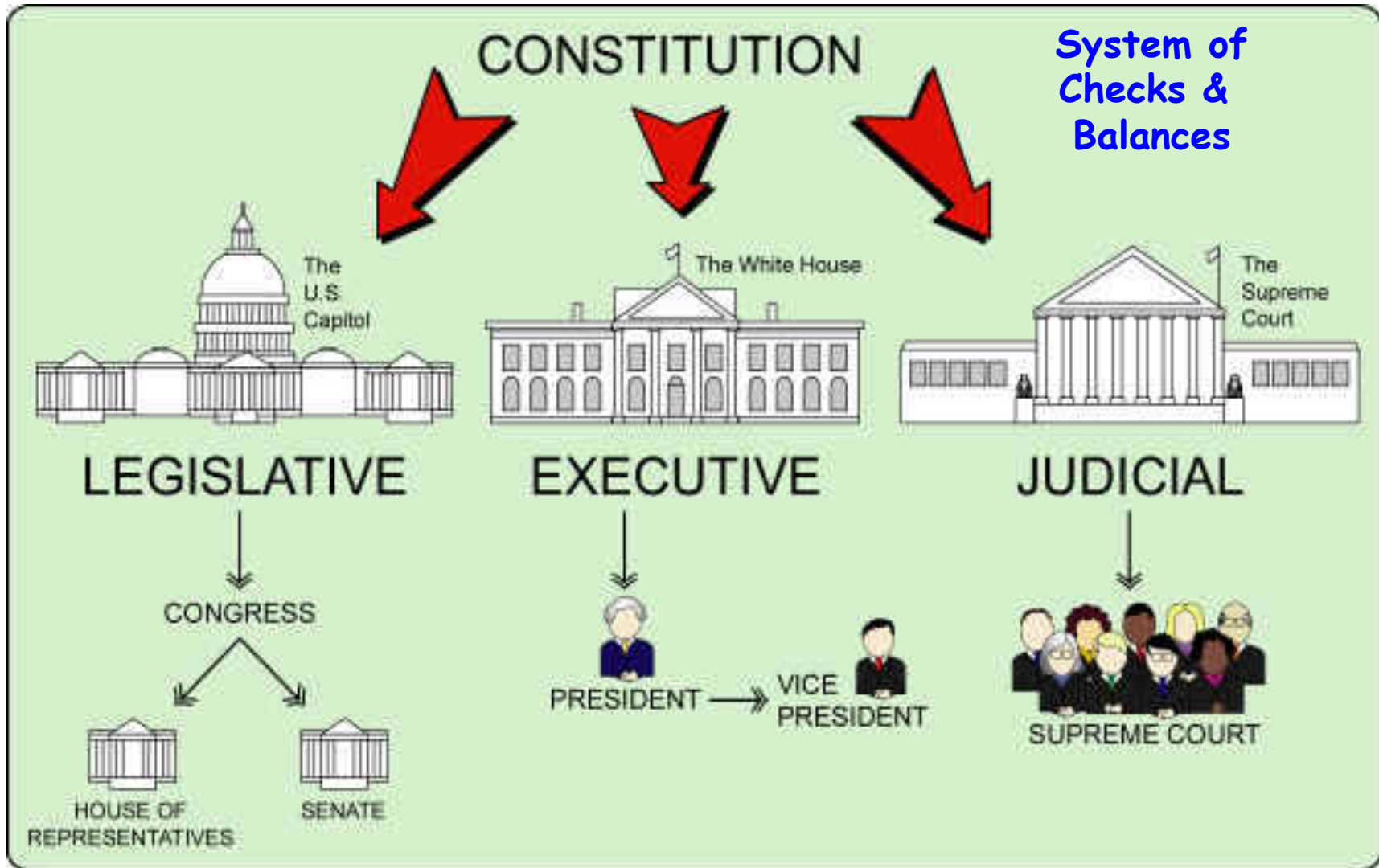
Plants of Tomorrow

## What Enables the Federal Government & States To Enact Laws Regarding Science?

- **Constitution-Article I Section 8.8**  
**Promote the General Welfare**
- **Amendments-Bill of Rights**
- **Amendment X-Powers Reserved to States**
- **Federal Criminal Statutes**
- **State Constitutions**
- **State Tort & Criminal Statutes**

# Organization of the United States Government

NO Precedent For This Form of Government in 1789-"Invented" From Scratch!

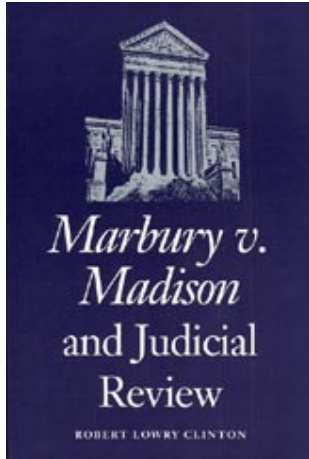


1776, David McCullough

John Adams, David McCullough

Founding Brothers, Joseph Ellis





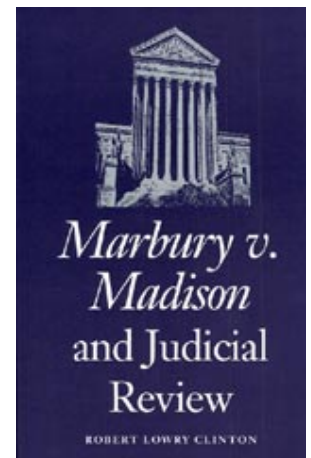
## Marbury v. Madison-1803

The critical importance of Marbury is the assumption of several powers by the Supreme Court. One was the authority to declare acts of Congress, and by implication acts of the president, unconstitutional if they exceeded the powers granted by the Constitution. But even more important, the Court became the arbiter of the Constitution, the final authority on what the document meant. As such, the Supreme Court became in fact as well as in theory an equal partner in government, and it has played that role ever since.

Chief Justice John Marshall

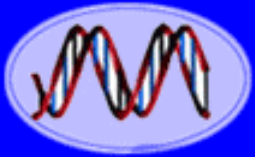
Activist Judges?

Voting Rights, Civil Rights, Age & Gender Discrimination  
Affirmative Action, etc,



## How Does the Constitution Affect Science Directly or Indirectly?

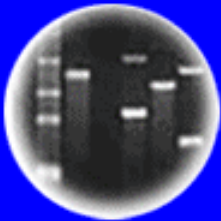
<b>Article or Amendment</b>	<b>What Is Application?</b>
Preamble	Promote the General Welfare
Article I, Section 8.1	Promote the General Welfare
Article I, Section 8.8	Patents & Copyrights
Article I, Section 8.18	Make All Laws to Execute
Amendment I	Freedom of Speech
Amendment IV	Searches & Seizures
Amendment V	Due Process-Privacy-Federal
Amendment VI	Federal Supremacy Clause
Amendment X	Powers Reserved to the States (Police Powers)
Amendment XIII	Slavery
Amendment XIV	Due Process-Privacy-State



DNA  
Genetic Code of Life



Entire Genetic Code  
of a Bacteria



DNA Fingerprinting

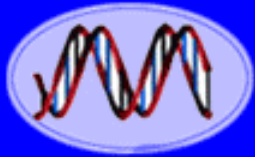


Cloning: Ethical Issues  
and Future Consequences



Plants of Tomorrow

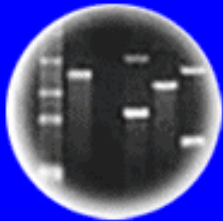
# And How Do These Articles and Amendments Apply to Science?



DNA  
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DNA Fingerprinting



Cloning: Ethical Issues  
and Future Consequences



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What Does the Constitution  
Say Directly About Science?

Is the Word “Science” in the  
Constitution?

# 1. Article I - Section 8.8

**The Congress shall have the Power:**

[8] “To Promote the Progress of Science and the useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their Writings and Discoveries”

Keyword: Inventors not Science.

Wanted to Promote Economic Development & Promote a National Economics Policy Grounded in Property Rights.

That is, Entrepreneurship!

**PATENTS!!**

# Article I - Section 8.8

## Intellectual Property

- Regulate Patents (genes, genetic engineering, cells)
- Regulate Copyrights (software)
- Regulate Trademarks (biotech companies, drugs)

What IS Patentable & What Are the Rules (e.g., 20 y)?

## Article I - Section 8.18

The Congress shall have the Power:

[18] “To make all Laws which shall be necessary and proper for carrying into Execution the forgoing Powers, and all other Powers vested by this Constitution in the Government of the United States, or in any Department or Officer thereof.

Key Concept: Congress Established Patent and Trademark Office (USPTO) and Intellectual Property laws

# How Does the Constitution Deal Indirectly With Science?

Without Using the Word Science or  
Mentioning the Progress of Science and  
Discoveries?



## Preamble

“We the People of the United States, in order to form a more perfect Union, establish justice, insure domestic tranquility, provide for the common defense, promote the General Welfare.....”

Key Concept: General Welfare-Which Can Apply to Almost Everything Dealing With Science, Health, Medicine, Agriculture, and Safety!

## Article I - Section 8.1

### The Congress shall have the Power:

[1] “To lay and collect Taxes, Duties, Imposts, and Excises, to pay the Debts and provide for the common Defense and general Welfare of the United States; but all Duties, Imposts, and Excises shall be uniform throughout the United States”

Key Concept: Provide For the General Welfare-Which Can Apply to Almost Everything Dealing With Science, Health, Medicine, Agriculture, and Safety!

# Article I - Section 8.1

## Promote the General Welfare: Federal Powers

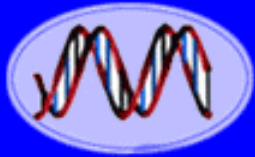
- Fund Science Research & Exploration
- Regulate Health (e.g., disease outbreaks)
- Regulate Medical Testing Devices/Services (DNA Testing)
- Regulate Drugs
- Regulate Food Additives
- Regulate Releases Into the Environment (GMOs)
- Regulate Lab Conditions
- Regulate Private DNA Testing/Sequencing Services
- Regulate Human Cloning and Stem Cell Funding
- Establish DNA Databases
- Establish Criminal Codes/Laws

# Article I - Section 8.1

## Congress Established Under This Article:

- Smithsonian Institute (1846)
- National Academy of Sciences (1863)
- National Bureau of Standards (1901)
- Public Health Service (1912)
- National Institutes of Health (1930)
- National Science Foundation (1946)
- USDA, EPA, FDA, CDC, NASA, OSHA, CODIS, USPTO, NOAA, etc., etc.

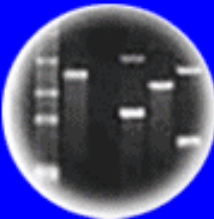
Key Concept: All Vested Under Constitutional Grant to Congress to Promote the General Welfare-All Involved in Science, Medicine, Agriculture, & Technology Activities



DNA  
Genetic Code of Life



Entire Genetic Code  
of a Bacteria



DNA Fingerprinting



Cloning: Ethical Issues  
and Future Consequences



Plants of Tomorrow

# What Does the Bill of Rights Say **Indirectly** About Regulating Science?



# Amendment I

## Freedom of Speech and Expression:

“Congress shall make no Law respecting an establishment of religion, prohibiting the free exercise thereof; or abridging freedom of speech, or of the press, of the right of the people peacefully to assemble, and to petition the Government for a redress of grievances.”

Key Concepts: Freedom to Think About Science, Publish, and Discuss Science in Meetings and Laboratories

# HAVE AN ABSOLUTE RIGHT TO CARRY OUT SCIENTIFIC INQUIRY AND RESEARCH

1. **Freedom of Speech Includes Right to Scientific Inquiry** - Have the Right to Think About Nature, Ponder Hypotheses, and How Nature Works. Have the Right to do Research and Advance the State of Knowledge
2. **Freedom of the Press Includes Right to Publish** - Have Right to Publish Scientific Theories, Hypotheses, and Results. BUT NOT ABSOLUTE (Freedom of Speech is not absolute). Therefore, could be outweighed by PUBLIC INTEREST (e.g., publishing how to make bioweapons or a nuclear bomb).
3. **Freedom to Assemble Peacefully** - Have Right to Come Together in a Meeting, Conference, and/or Laboratory to Do Research and Communicate Research Results and Exchange Ideas, Seek Truth, and/or Learn About Science and Nature

**Can Scientific Inquiry and  
Research Be Regulated?**



**YES**-HAVE AN ABSOLUTE RIGHT TO THINK,  
IMAGINE, FORM GROUPS, ARGUE IDEAS,  
AND DO RESEARCH

**BUT WHAT ABOUT ACTUALLY CARRYING OUT  
EXPERIMENTS IN A LABORATORY OR IN A  
HOME, OR BUSINESS?**

**CAN EXPERIMENTATION (e.g, recombinant dna,  
stem cells) BE REGULATED?**

# THERE IS NO FUNDAMENTAL RIGHT OF SCIENTIFIC INQUIRY TO CARRY OUT EXPERIMENTS!

- 1. V
- 2. C
- 3. E
- 4. F



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Right

Experimentation CAN BE Regulated Directly By Law and/or Indirectly By Funding!

**Can Think But Can't Always Act!**

# Amendment IV

## Searches and Seizures:

“The right of the people to secure their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no warrants shall issue, but upon probable cause, supported by Oath or affirmation, and particularly describing the place to be searched and the persons or things to be seized”

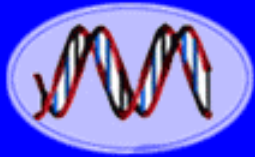
Key Concepts: Right Against Unreasonable Searches to Your Own “Body Parts,” Science Writings, and Experimental Materials

# Amendment IV

## Searches and Seizures

- Body Parts (e.g., hair)
- Saliva (DNA testing)
- Blood (DNA testing)
- Cheek Swab (DNA testing)
- Lab Notebooks, Records

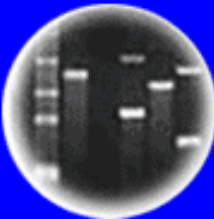
No DNA Sampling “Sweeps” -For Example an Entire An Entire Neighborhood



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Entire Genetic Code  
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DNA Fingerprinting



Cloning: Ethical Issues  
and Future Consequences



Plants of Tomorrow

## Appeals court upholds DNA testing of felony suspects

*A panel of the 9th Circuit Court of Appeals rules that collecting a DNA sample from anyone arrested in a felony case doesn't violate their protection from unreasonable searches and seizure.*

February 24, 2012 | By Carol J. Williams, Los Angeles Times

Law enforcement officers may take a DNA sample from anyone arrested on a felony charge without running afoul of the suspect's right to be free from unreasonable search and seizure, a divided federal appeals court ruled Thursday.

The challenge brought by a group of Californians arrested for alleged felonies but never convicted upheld a 2004 amendment to the state's laws governing DNA collection and use.

In a 2-1 ruling, a panel of the U.S. 9th Circuit Court of Appeals compared taking an oral swab from a suspect with fingerprinting arrestees, a decades-old booking practice consistently upheld by the courts as a legitimate identification aid.

"We assess the constitutionality of the 2004 amendment by considering the 'totality of the circumstances,' balancing the arrestees' privacy interests against the government's need for the DNA samples," said the opinion written by Judge Milan D. Smith Jr.

"DNA analysis is an extraordinarily effective tool for law enforcement officials to identify arrestees, solve past crimes, and exonerate innocent suspects," wrote Smith, who was named to the court by President George W. Bush, in an opinion joined by a visiting Tennessee judge appointed by President Reagan. "After weighing these factors, we conclude that the government's compelling interests far outweigh arrestees' privacy concerns."

California  
Proposition 69  
Requiring DNA  
Samples to be  
Taken of All  
Felony  
Arrestees is  
Constitutional

## Federal appeals court upholds DNA 'test on arrest'

Like 30 Tweet 18 +7 0

Comments (5)

By JOSH GERSTEIN | 2/23/12 6:36 PM EST

A divided federal appeals court panel has upheld the constitutionality of California's DNA "test on arrest" policy, which is building a massive database compiled from the DNA of people arrested for felonies in the Golden State — regardless of whether they are ultimately convicted of anything.

The "test on arrest" policy has been **endorsed by President Barack Obama**, who has encouraged states and federal governments to link up their databases in order to solve crimes. Law enforcement officials say DNA databases have solved numerous crimes, including murders and sex assaults.

In a 2-1 decision issued Thursday (and posted [here](#)), the U.S. Court of Appeals for the 9th Circuit ruled that collecting and maintaining the DNA sample — obtained from swabbing the inside of an arrestee's mouth — does not violate the Fourth Amendment's protection against unreasonable searches and seizures.

"The physical extraction of DNA using a buccal swab collection technique is little more than a minor inconvenience to felony arrestees, who have diminished expectations of privacy. Moreover, it is substantially less intrusive, both physically and emotionally, than many of the other types of approved intrusions that are routinely visited upon arrestees," Judge Milan Smith wrote in an opinion joined by Judge James Todd, a district judge assigned to the appellate panel.

# Amendment V

## Due Process:

“No Person shall be held to answer for a capital, or otherwise infamous crime, **unless on presentment or indictment of a Grand jury**, except in cases arising in the land or navel forces, or in the Militia, when in actual service in time of War or public danger; **nor shall any person be a subject for the same offense to be twice put in jeopardy of life and limb, nor shall be compelled in any criminal case to be a witness against himself.** Nor be deprived of Life, liberty, or property, without due process of law; nor shall any property be taken for public use without just compensation.”

Key Concepts: Right to Life & Liberty=Privacy=Reproductive Rights  
Medical Treatment (Refusal/Acceptance)

# Amendments V and XIV

Federal Due Process (Right to Privacy)

State Due Process (Right to Privacy)

Right to Life (Medical Treatment)

- Procreative Choice-Terminate Pregnancy (genetic testing: PGS, amniocentesis, chorionic villi sampling)
- In Vitro Fertilization
- Stem Cells
- Birth Control
- Cloning (therapeutic, reproductive?)
- Medical Treatment (life)



# Amendments V and XIV

## Planned Parenthood vs. Casey (1992)

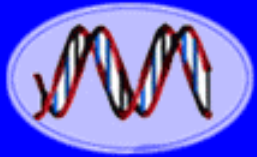
At the heart of liberty is the right to define one's own concept of existence, of meaning, of the universe, and of the mystery of human life."

## Griswold v. Connecticut (1965)

Involved a Connecticut law (1879) that prohibited the use of any drug, medicinal article or instrument for the purpose of preventing conception

"Would we allow the police to search the sacred precincts of marital bedrooms for telltale signs of the use of contraceptives? The [381 U.S. 479, 486] The very idea is repulsive to the **notions of privacy** surrounding the marriage relationship."

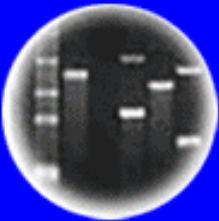
*Justice William O. Douglas*



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DNA Fingerprinting



Cloning: Ethical Issues  
and Future Consequences



Plants of Tomorrow

Should There Be Laws Regulating Human Cloning?

- a. Yes
- b. No

# Amendment VI

The Constitution, and the laws of the United States which shall be made in pursuance thereof; and all treaties made, or which shall be made, under authority of the United States, **shall be the supreme law of the land**; and the judges in every State shall be bound thereby, anything in the Constitution, or laws of any State to the contrary notwithstanding

**State laws that conflict with Federal law are "without effect"**  
**A Federal law that conflicts with State law will "preempt" State Law**  
Altria Group vs. Good, 2008; Maryland vs. Louisiana, 1981

## California GMO Labeling Initiative



[www.FactsOn37.com](http://www.FactsOn37.com)

What About Federal Preemption?



# Amendment X

## Powers Not Delegated to the United States:

“The powers not delegated to the United States by the Constitution, nor prohibited by it to the States, are reserved to the States respectively, or to the people.”

- *Gibbons vs. Ogden* (1824) - Justice John Marshall - “that immense mass of legislation which embraces everything within a territory or state.....”
- *Brown vs. Maryland* (1827) - Justice John Marshall - defined the totality of state legislative power the “police powers.”
- *Barnes vs. Glen Theatre, Inc.* (1991) - Justice William Rehnquist - “the traditional police powers of the states is defined as the authority to provide for the public health, safety, and morals”

Key Concept: State Promotion of General Welfare=Police Powers

# Amendment XIII

## Involuntary Servitude:

Section 1: “Neither slavery nor involuntary servitude, except as punishment for crime whereof the party shall have been duly convicted, shall exist with the United States, or any place subject to their jurisdiction.”

Section 2: “Congress shall have the power to enforce this article by appropriate legislation

Key Concept: No Slavery or Involuntary Servitude-Clones or Patenting Humans

# Amendment X

## Police Powers to States & Localities

### State Funding and Regulation of:

- Science Research & Exploration
- Health (e.g., disease outbreaks)
- Medical Testing Devices/Services (DNA Testing)
- Drugs (as long as not interstate commerce)
- Food Additives
- Releases Into the Environment (GMOs)
- DNA Data Bases, etc.

# Laws Exist That Regulate Science at the State Level



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NCSL Home > *State & Federal Issues: Issue Areas* > Criminal Justice > NCSLnet: 50 State Laws on DNA Data Banks [Add to MyNCSL](#)

## State Laws on DNA Data Banks

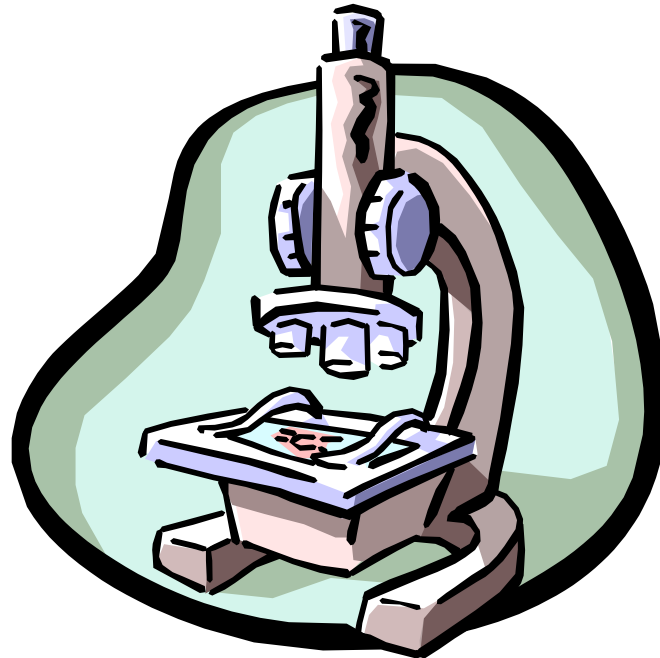
### Qualifying Offenses, Others Who Must Provide Sample

February 2009

e.g., State Laws on DNA Data Banks

State	All Felonies	Some Juveniles	Some Misdemeanors	Some Arrestees	Not Guilty By Mental Defect or GBMI	Other
Alabama	X					
Alaska	X	X		X -- Violent felonies.		
Arizona	X	X		X -- Many serious felonies.		Includes residential and criminal burglary.
Arkansas	X	X -- Violent crimes only.	X -- Some sexual offenses.		X	
California	X	X		X -- Expansion to all felon arrestees starts in 2009.		Includes those convicted of terrorist activity in violation of weapons of mass destruction provisions; and those convicted of a qualifying offense in another state.

# How Can Genetic Engineering Be Regulated Directly?





Police Powers of Federal, State, and  
Local Governments-To Promote the  
General Welfare-Can Regulate  
Experimentation.

“If Inherently Hazardous to Protect  
the Welfare of the Public and/or an  
Individual”

# Recombinant DNA – Cambridge, MA. City Council – 1977

- **Facts:** Cambridge City Council Tried to Ban All Recombinant DNA Experiments in the City of Cambridge, Including Harvard University. *“Threats of diseases and monsters that could be brought about by recombinant DNA....gene splicing should be banned within the city limits.”*
- **Outcome:** After a Heated Debate, the Cambridge Experimental Review Board (CERB) Recommended Going Forward With Recombinant DNA Under NIH Guidelines. *“A citizen’s jury (CERB) of lay people and scientists came to a sensible conclusion, and that was the ordinance that passed.”*



# Sale of Genetically Engineered GloFish in CA — 2003



- **Facts:** Fish and Game Commission of CA Was Asked to Renew License to Do Research on Genetically Modified Fish
- **Outcome:** Citing ethical concerns, state regulators Wednesday refused to allow sales of the first bio-engineered household pet, a zebra fish that glows fluorescent. The 3-1 vote came moments after commissioners approved the state's 14th license for research into genetically modified fish. *But commissioners drew the line on permitting widespread sales of a biotech fish for pure visual pleasure.*

**Background:** California adopted its regulations for fear genetically modified farmed fish, such as salmon, could get loose and devastate the state's wild populations. "Welcome to the future. Here we are, playing around with the genetic bases of life," Schumchat said. "At the end of the day, I just don't think it's right to produce a new organism just to be a pet. To me, this seems like an abuse of the power we have over life, and I'm not prepared to go there today."

*California Fish and Game Code - 2007 - Outright Ban on Release of Transgenic Fish*

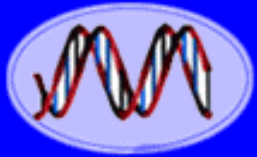
# Bioterrorism: Congressional Legislation to Improve Public Health Preparedness and Response Capacity-2002

- **Facts:** To Protect Nation From Bioterrorism Attacks After 9/11 and Anthrax “Attacks” on Congress
- **Outcome:** Bioterrorism Preparedness Act of 2002

**Background:** Funds For Research on Pathogens To Uncover Knowledge Required to Counteract Bioweapons’ Attacks (e.g., antibiotics, vaccines). Requires registration of all human pathogens and pathogen research in US Laboratories.



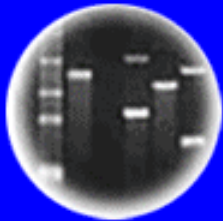
**Principle:** Public Safety/Welfare Risk



DNA  
Genetic Code of Life



Entire Genetic Code  
of a Bacteria



DNA Fingerprinting



Cloning: Ethical Issues  
and Future Consequences



Plants of Tomorrow

# STATE ARRESTEE DNA TESTING LAWS

California  
Proposition 69  
Requiring DNA  
Samples to be  
Taken of All  
Felony  
Arrestees is  
Constitutional –  
For Now



## Federal appeals court upholds DNA 'test on arrest'

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Comments

(5)

By JOSH GERSTEIN | 2/23/12 6:36 PM EST

A divided federal appeals court panel has upheld the constitutionality of California's DNA "test on arrest" policy, which is building a massive database compiled from the DNA of people arrested for felonies in the Golden State — regardless of whether they are ultimately convicted of anything.

The "test on arrest" policy has been **endorsed by President Barack Obama**, who has encouraged states and federal governments to link up their databases in order to solve crimes. Law enforcement officials say DNA databases have solved numerous crimes, including murders and sex assaults.

In a 2-1 decision issued Thursday (and posted [here](#)), the U.S. Court of Appeals for the 9th Circuit ruled that collecting and maintaining the DNA sample — obtained from swabbing the inside of an arrestee's mouth — does not violate the Fourth Amendment's protection against unreasonable searches and seizures.

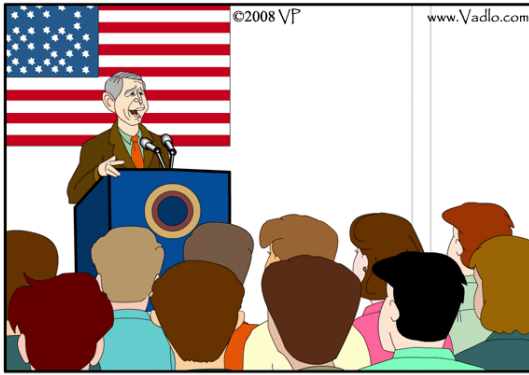
"The physical extraction of DNA using a buccal swab collection technique is little more than a minor inconvenience to felony arrestees, who have diminished expectations of privacy. Moreover, it is substantially less intrusive, both physically and emotionally, than many of the other types of approved intrusions that are routinely visited upon arrestees," Judge Milan Smith wrote in an opinion joined by Judge James Todd, a district judge assigned to the appellate panel.

## Supreme Court to hear fight over taking DNA from arrested people

The Supreme Court will hear a privacy rights challenge to the police practice of taking DNA from people arrested but not yet convicted.

By David G. Savage, Washington Bureau

10:12 PM PST, February 2, 2013



I have ordered science grants to be distributed by National Lottery Commission.



# How Can Genetic Engineering and Science Be Regulated Indirectly?



# Regulate Through Power of Funding and Research \$

1. No Constitutional Right to Obtain Funding For Research at Federal, State, and Local Levels
  - a. Federal Embryonic Stem Cell Research Restricted
  - b. Must Apply For Grants Which Are Merit-Based and Peer-Reviewed
  
2. Must Abide By Conditions of Funding Agencies to Obtain Research \$
  - a. Recombinant DNA Guidelines
  - b. Human Institutional Review Boards (IRBs)
  - c. Release of GMOs Into the Environment (EPA)
  - d. Destruction of Human Embryos

# UCLA Biohazard Committee Approvals

## 1978

UNIVERSITY OF CALIFORNIA, LOS ANGELES  
BIOHAZARDS COMMITTEE

### Approval Notice

PRINCIPAL INVESTIGATOR OF MAIN GRANT: Robert B. Goldberg  
TITLE OF MAIN GRANT: Isolation of Seed Storage Protein Genes for the Soybean Plant  
PRINCIPAL INVESTIGATOR OF PROTOCOL: Same as above FUNDING AGENCY: NIH  
DEPARTMENT: Biology CONTRACT OR GRANT NO. (If known): \_\_\_\_\_  
DIVISION: \_\_\_\_\_ DATES FOR WHICH REVIEWED: FROM: 4-1-79 TO: 3-31-80  
TITLE OF PROJECT: Organization and Expression of Seed Storage Protein Genes in Soybean Development DATE FOR RE-SUBMISSION: 2-28-80  
DATE APPROVED: 5-18-78  
ACTUAL STARTING DATE OF PROTOCOL: 4-1-79

The Biohazards Committee has reviewed the proposed use of recombinant DNA molecules in the project identified above and assures that:

The applicable facilities and procedures have been reviewed by the Biohazards Committee and judged to be both adequate and consistent with the requirements of the NIH guidelines.

The Biohazards Committee will monitor the facilities and procedures throughout the duration of the project.

P2-EK1

Date: May 18, 1978 Signature: David D. Post  
Chairman, Biohazards Committee

Original to: National Institutes of Health  
cc to: Director, Office of Contract and Grant Administration  
Principal Investigator ✓

### MEMORANDUM OF UNDERSTANDING AND AGREEMENT

1. As principal investigator I am familiar with the NIH Guidelines for Research Involving Recombinant DNA Molecules (issued June 23, 1976 and published in the Federal Register, July 7, 1976). I agree to abide by their provisions.

Signed Robert B. Goldberg  
Robert B. Goldberg  
Assistant Professor of Biology

2. Experiments which involve recombinant DNA molecules.
  - A. Background. "Organization and Expression of Seed Storage Protein Genes in Soybean Development"

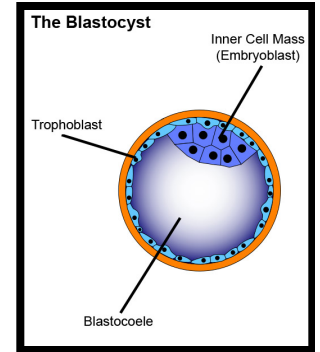
3. An assessment of the levels of physical and biological containment required by the current NIH Guidelines for these experiments.

The formation of hybrids between plant DNA and bacterial plasmids is given a P2-EK1 classification provided that the plant does not harbor a pathogenic agent nor produce a product toxic to other species (NIH Guidelines, III-18). Plant varieties to be used in experiments with plasmid DNAs do not harbor known plant viruses or pathogenic bacteria, nor do they produce any toxic product. As such I assess a P2-EK1 level of containment as appropriate for these experiments.





# Federal Stem Cell Research Funding



## Part IV

# The President

**Executive Order 13505—Removing Barriers to Responsible Scientific Research Involving Human Stem Cells**

**Memorandum of March 9, 2009—Presidential Signing Statements**

**Memorandum of March 9, 2009—Scientific Integrity**

Executive Order 13505 of March 9, 2009

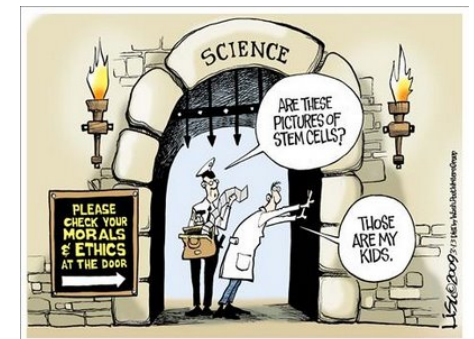
### Removing Barriers to Responsible Scientific Research Involving Human Stem Cells

By the authority vested in me as President by the Constitution and the laws of the United States of America, it is hereby ordered as follows:

**Section 1. Policy.** Research involving human embryonic stem cells and human non-embryonic stem cells has the potential to lead to better understanding and treatment of many disabling diseases and conditions. Advances over the past decade in this promising scientific field have been encouraging, leading to broad agreement in the scientific community that the research should be supported by Federal funds.

For the past 8 years, the authority of the Department of Health and Human Services, including the National Institutes of Health (NIH), to fund and conduct human embryonic stem cell research has been limited by Presidential actions. The purpose of this order is to remove these limitations on scientific inquiry, to expand NIH support for the exploration of human stem cell research, and in so doing to enhance the contribution of America's scientists to important new discoveries and new therapies for the benefit of humankind.

**Sec. 2. Research.** The Secretary of Health and Human Services (Secretary), through the Director of NIH, may support and conduct responsible, scientifically worthy human stem cell research, including human embryonic stem cell research, to the extent permitted by law.



# Direct and Indirect Regulation of *Genetic Engineering*: Summary

1. Recombinant DNA-Gene Splicing Experiments
  - a. Directly By Regulation at Federal, State, and Local Levels By Police Powers To Protect the General Welfare
  - b. Indirectly by Funding Agencies
  
2. Transgenic Microbes, Animals, and Plants
  - a. Release Into The Environment, Altered Food Composition, Use as “Pesticides.”
  - b. Directly By Federal Agencies & State Police Powers, and Indirectly By Funding Requirements