



# Animal Biotechnology

## How, What and Why?

Alison Van Eenennaam, Ph.D.

Cooperative Extension Specialist  
Animal Biotechnology and Genomics

[alvaneennaam@ucdavis.edu](mailto:alvaneennaam@ucdavis.edu)



<http://animalscience.ucdavis.edu/animalbiotech/>

**Vallejo 5/7/2010**

Animal Biotechnology and Genomics Education



# Animal Breeding – selection of dog breeds





# What is Biotechnology ?



**Biotechnology** - The application of science and engineering to living organisms.







# Animal biotechnology

- Artificial selection (breeding programs)  
How do farmers make their selection decisions – which bull to use?





**Holstein -  
Dairy**

**Angus -  
Beef**





**DREAM ON** 29SM0373



**CHS DREAM ON L186** ASA 2144976

[View Support Photos](#)

NICHOLS LEGACY G151

NICHOLS BLK DESTINY D12

NICHOLS DEBRA D81

CNS SHEEZA DREAM K107W

SRS FRANCHISE F601

NICHOLS JOLIETTE 107W

**2007 GENETIC TYPE SUMMARY**

		STA #HEAD				
		-2	-1	0	1	2
Stature	-0.4 PE					
Capacity	0.2 PE					
Body Length	0.4 PE					
Muscling	0.6 PE					
Rear Legs	-0.8 PE					
Feet & Pasterns	0.1 PE					
Femininity	0 PE					
Udder Attachment	PE					
Udder Depth	PE					
Teat Size	PE					

**Comments: Pedigree Estimate**

**Profitable and Marketable**

- Heterozygous black, DNA tested homozygous polled
- A leader for API (top 2%) combining outstanding calving ease, maternal calving ease, sensible growth and strong carcass traits
- The overall look and kind of his progeny make them extremely popular and easy to sell
- The best return on investment for your semen dollar

**AMERICAN SIMMENTAL SIRE SUMMARY FALL 2007**

TRAIT	CED	BW	WW	YW	MCE	MILK	MWW	STAY
EPD	+15.7	-0.9	+35.3	+58.6	+13.3	+6.9	+24.5	+16.3
ACC	.88	.95	.92	.90	.77	.80	.81	.15

TRAIT	CW	YG	MARB	BF	REA	SHR
EPD	-10.5	-.01	+.30	+.03	+.11	-.01
ACC	.66	.66	.66	.71	.64	.08

Individual Performance		
BW	78	
205	886	N/A
365	1,435	N/A
SC	40	12 Mo.
YFS/FS	6	
Weight	2,300	Mat.
Height	58	Mat.
Born: 11/21/01		







# Animal biotechnology

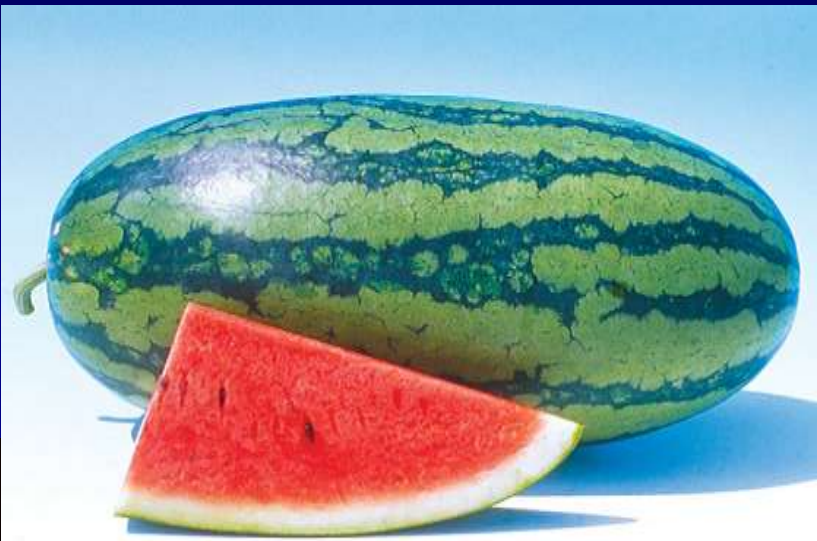
- Artificial selection (breeding programs)
- Artificial Insemination
- **Cloning**
- **Genetic engineering**





# Have I ever eaten a clone?

## YES







# What is a clone ?



- Cloning, in horticulture and biology, any organism whose genetic information is identical to that of a "mother organism" from which it was created.
- Food from clones has been a part of our diet for years. Many common fruits (e.g., pears, apples, oranges and lemons) and several vegetables (e.g., potatoes and truffles) are clones.



# What about cloned animals?





# Cloning by “natural reproduction” (monozygotic twins)



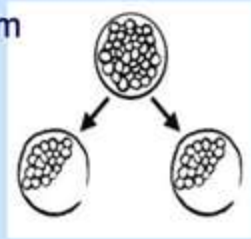




# Cloning by embryo splitting – has been done for 20 years

## Cloning by Embryo Splitting

Embryo is split to form  
two half-embryos



Embryos are transferred to an  
unrelated surrogate mother



Pregnancy is  
monitored by  
ultrasound



Sheep gives birth to  
identical twins



# Dolly the first adult cell cloned (1996)

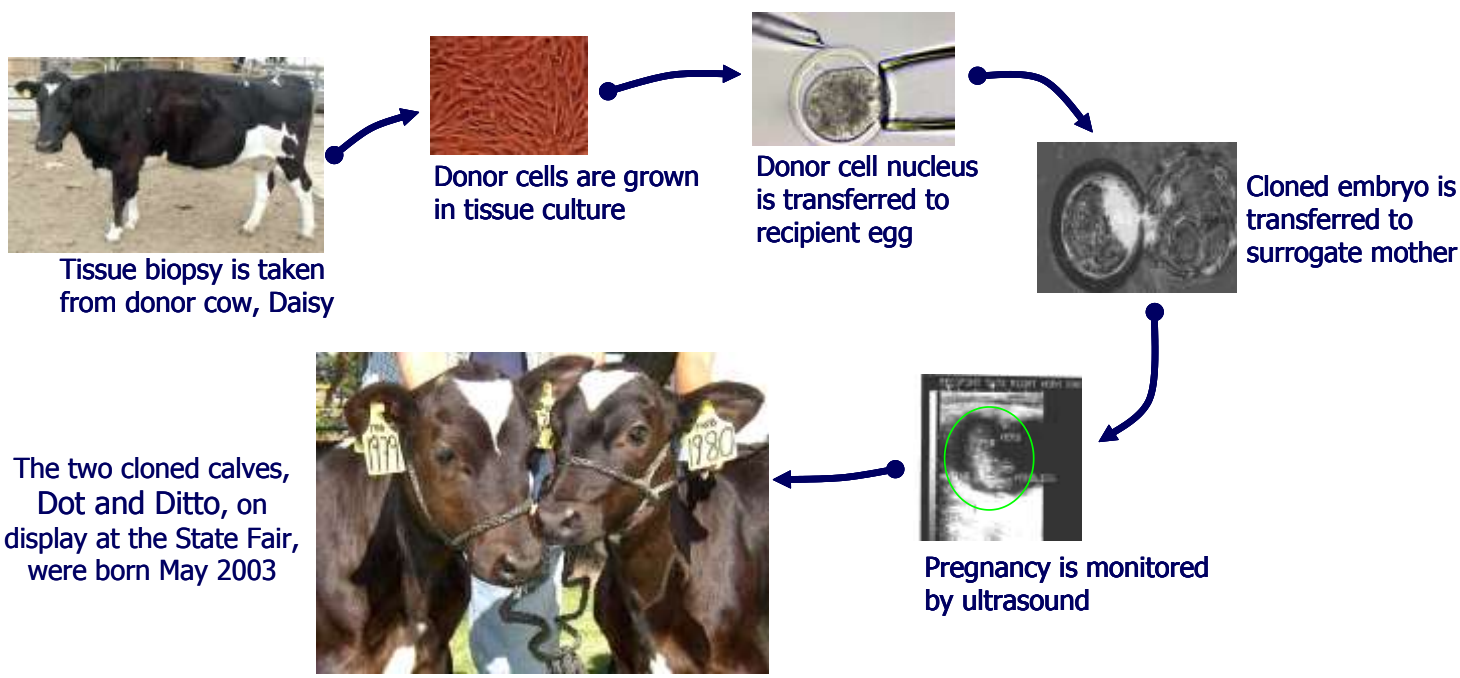




# Cloning by "Nuclear Transfer" (take nucleus and transfer it)

Embryo Transfer Laboratory

## Cloning by Nuclear Transfer at UCDAVIS







# Many animal species have been since been cloned from adult cells





# Who's Buying?

\$20,000

Regancrest Emory Derry died unexpectedly.







# Who's Buying?

- **Full Flush**

**Unable to supply market demand for his semen**



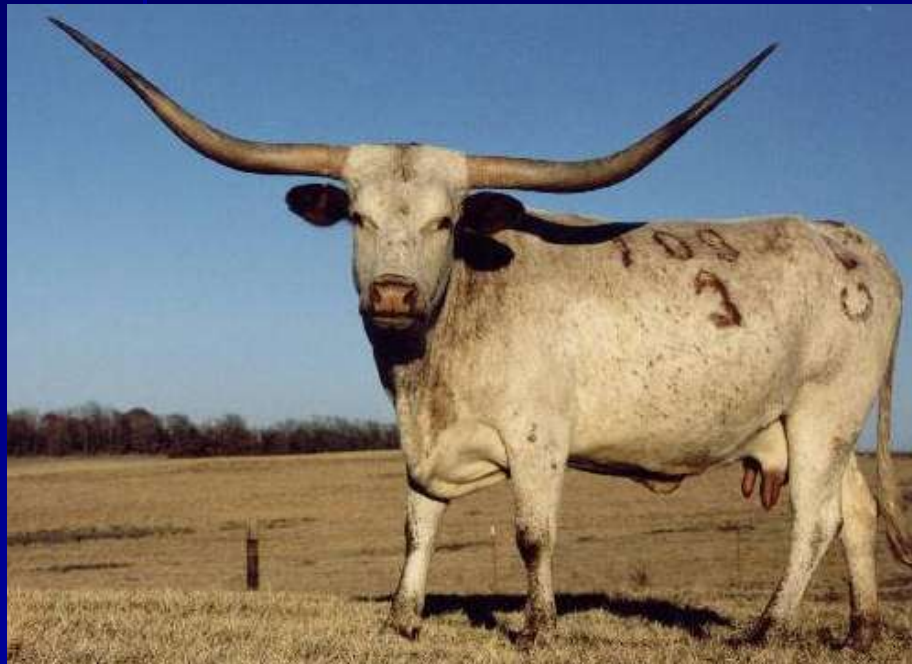




# Who's Buying?

## Specialty Cattle Producers

**Starlight:** record 77 inches 'tip to tip'





# What's up in the blogosphere ?

- **Posted by Christina**

"Will cloned food sources be labeled as such? I am certainly not in support of it, will avoid it and will continue to support organic food sources as much as possible. What are our leaders thinking and why, as a US Citizen and registered voter, don't I get a say in this? Very disturbing!"

- **Posted by Quignoff**

"There are many people that obviously do not know that we eat cloned, genetically engineered foods every single day. Nearly all of the plant foods that we eat have been engineered. Besides, our bodies have no idea that the food it's eating is cloned or not; dna is dna is dna as far as our stomachs and the microbes that live there are concerned."

- **Posted by Troy**

"Why not? Dead cow is dead cow regardless of its possible parentage."



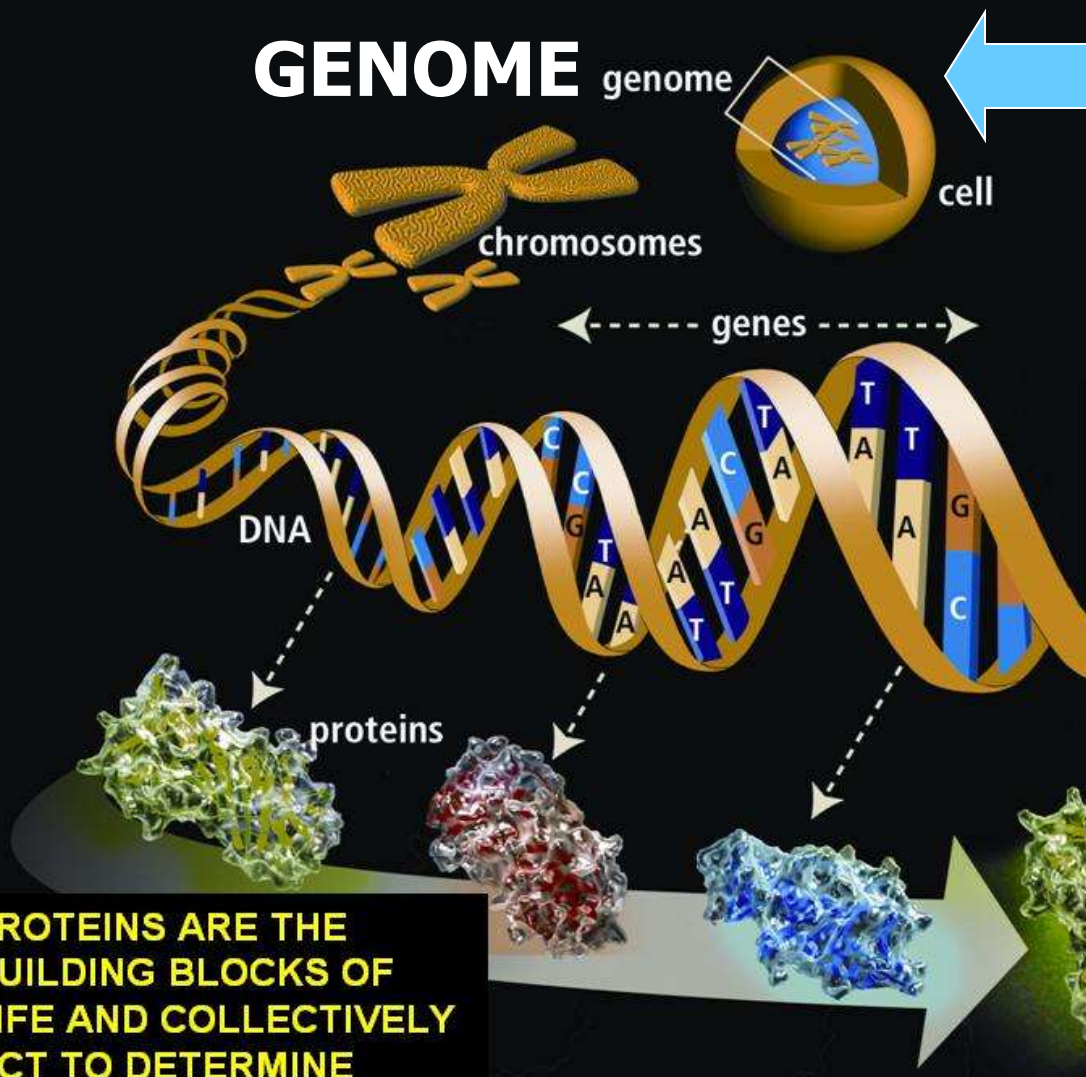


# Shift gears to Genetic Engineering





# What is DNA ?

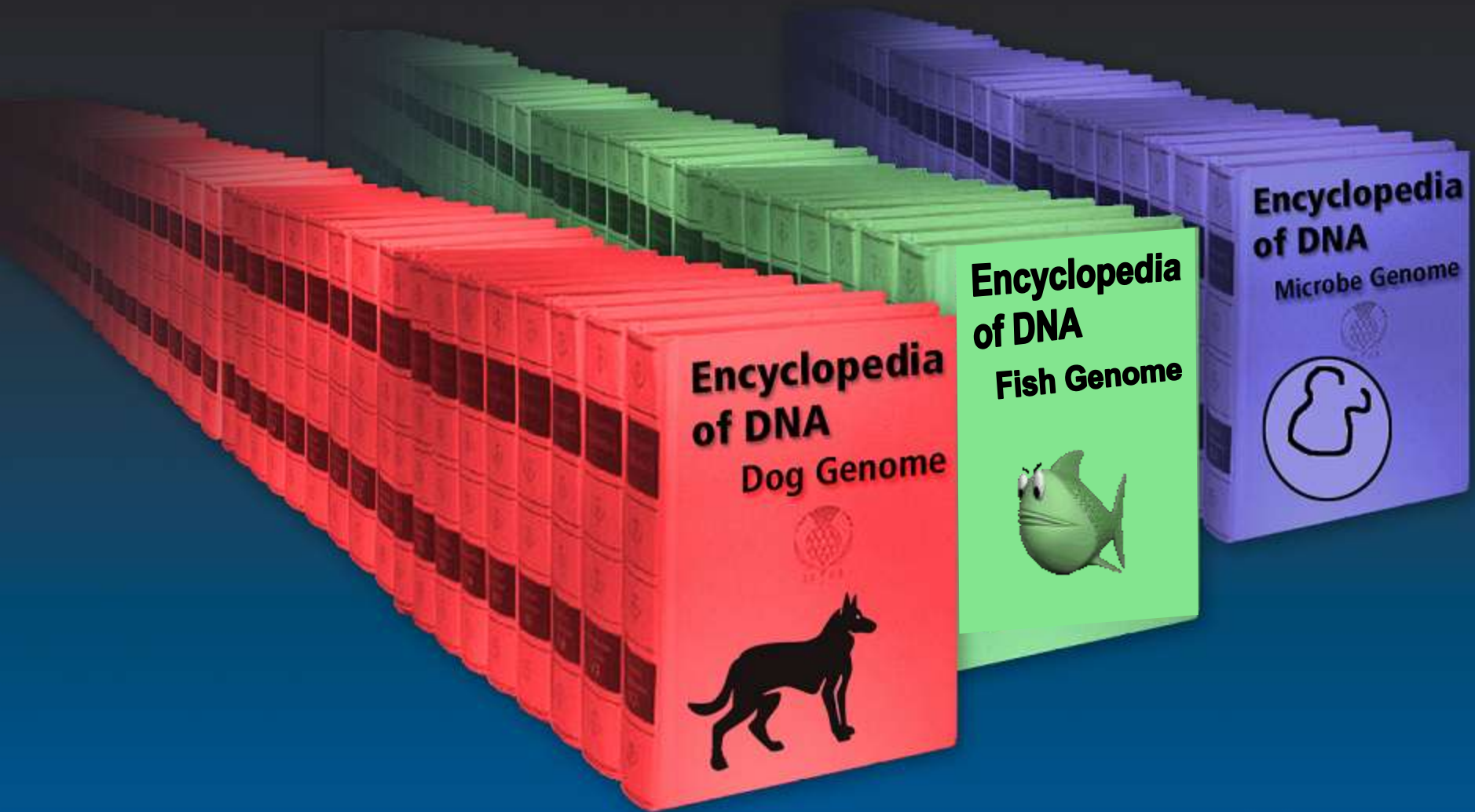


**PROTEINS ARE THE  
BUILDING BLOCKS OF  
LIFE AND COLLECTIVELY  
ACT TO DETERMINE  
PHENOTYPE**

# Encyclopedia of DNA Fish Genome







**Encyclopedia  
of DNA**  
Dog Genome



**Encyclopedia  
of DNA**  
Fish Genome



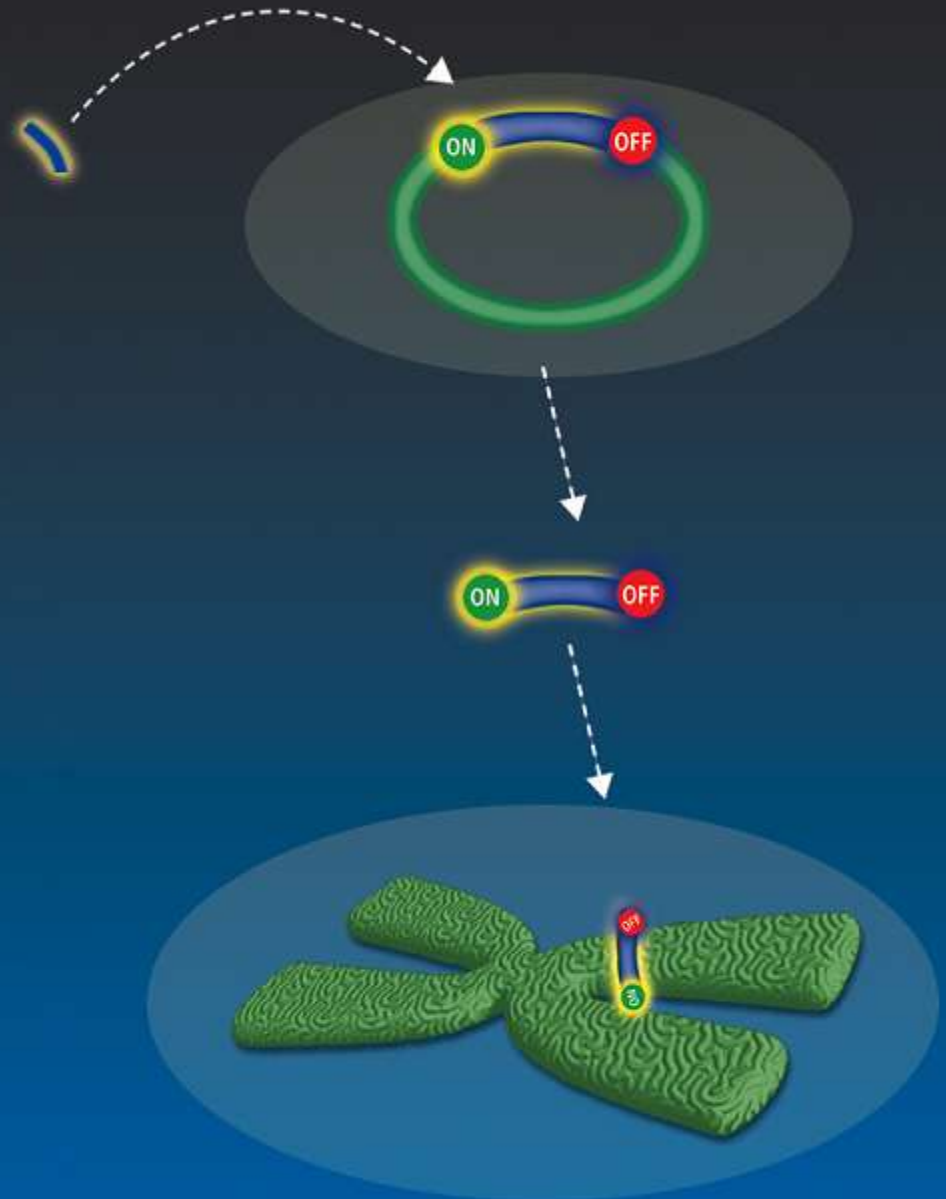
**Encyclopedia  
of DNA**  
Microbe Genome

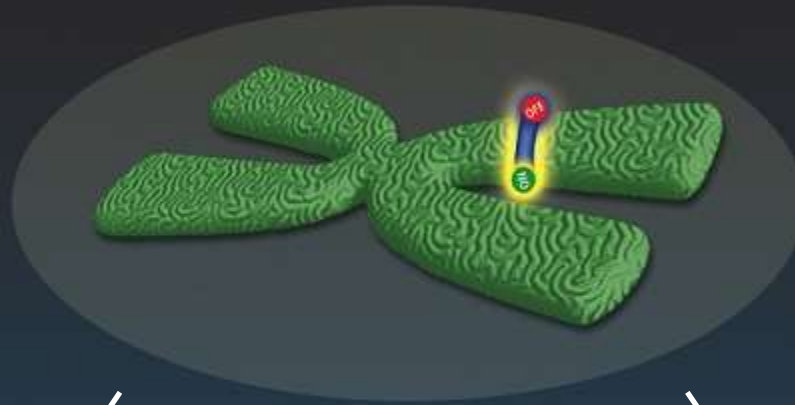






World Record 97 lb 4 oz. chinook salmon  
(Les Anderson, Kenai River, AK 1985)





18 month old salmon



# Enviropig™ (Low-phosphorus manure)

<http://www.uoguelph.ca/enviropig/>

World Business Newspaper <http://www.ft.com>



**Enviropig**  
Leaving pearls  
behind swine  
Page 21



Nature Biotechnology, 19, 741 - 745, (2001).





# Genetically engineered fish and cloned cats – oh my...





# Interfering with the integrity or *telos* of an animal

‘will lead to abnormal outcomes’  
‘man is playing God’  
‘will cause economic disaster’



A stylized graphic of a Jeopardy! game board. It features a central rectangular area with a grey background and a blue border decorated with yellow stars. Above and below this area are semi-circular sections with a pink and green striped pattern. The entire graphic is set against a blue background.

# Genetic JEOPARDY





# GENETIC JEOPARDY

## FIVE QUESTIONS

10

20

30

40

50



## ANSWER 1

**It is the application of  
science and engineering to  
living organisms**



## QUESTION 1

# What is biotechnology ?







## ANSWER 2

**It is the dairy cow**





## QUESTION 2

**What is the black and white cow (Holstein breed) ?**



## ANSWER 3

**It is the process of making a genetically identical copy of an individual.**





## QUESTION 3

# What is cloning ?





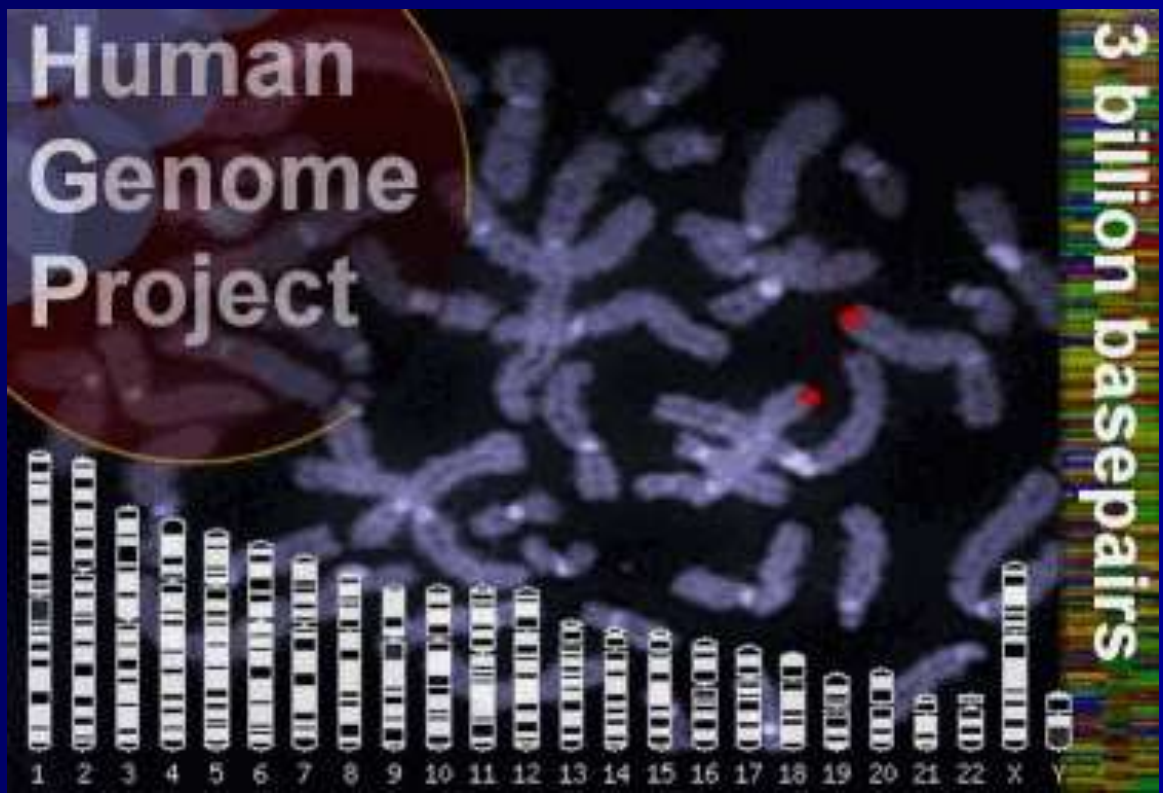
## ANSWER 4

**It is the name for all of the  
DNA in each cell of an  
organism.**



# QUESTION 4

## What is the genome ?







## ANSWER 5

**She was the first animal cloned from an adult cell.**



## QUESTION 5

**Who was Dolly (the sheep) ?**





# FINAL JEOPARDY

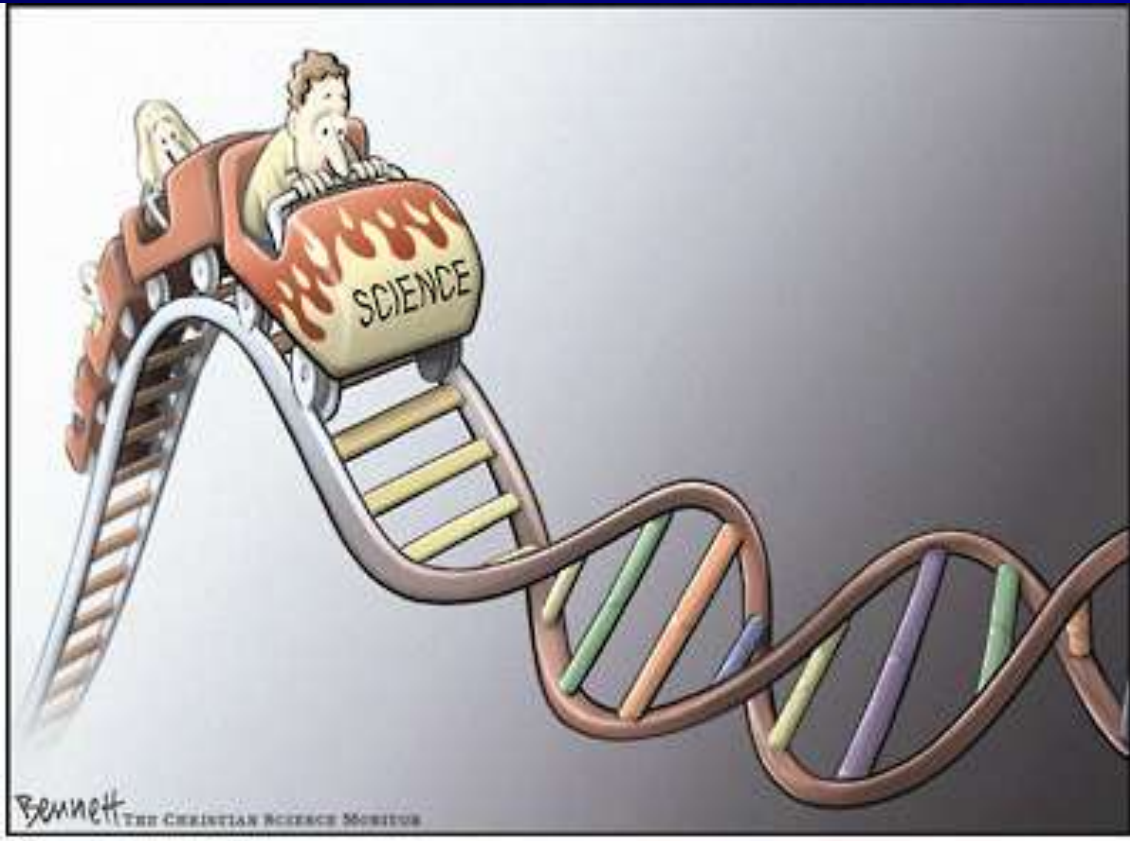
**It is a linear molecule that is shaped like a double helix and it is made up of pairs of nucleotides**





# FINAL JEOPARDY

What is DNA ?





B

