



**Pfizer Animal Health**  
Animal Genetics

# **Emerging DNA Technology: Enhancing the Need for ART!**

**2008 Applied Reproductive  
Strategies in Beef Cattle  
Fort Collins, CO**



**GeneSTAR<sup>®</sup>**





# ANGUS

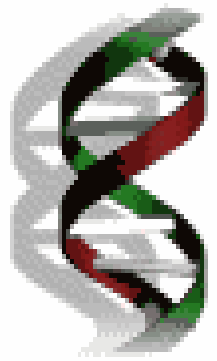
## THE BUSINESS BREED

AMERICAN ANGUS ASSOCIATION

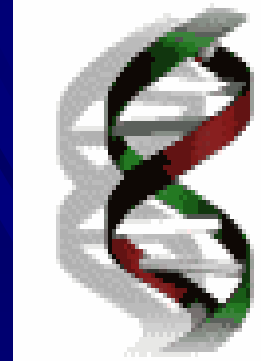
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*Late 1950s-  
Early 1960s*





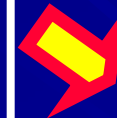
# Quantitative Genetics— Reduced Animal Model



Phenotypic  
data



“Breeding  
Value”  
for  
unknown  
polygenes



EPDs  
Within  
Breeds

Unknown  
genes



# AMERICAN ANGUS ASSOCIATION<sup>SM</sup> — THE BUSINESS BREED

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## Breed Average EPD and \$Values - Spring 2007

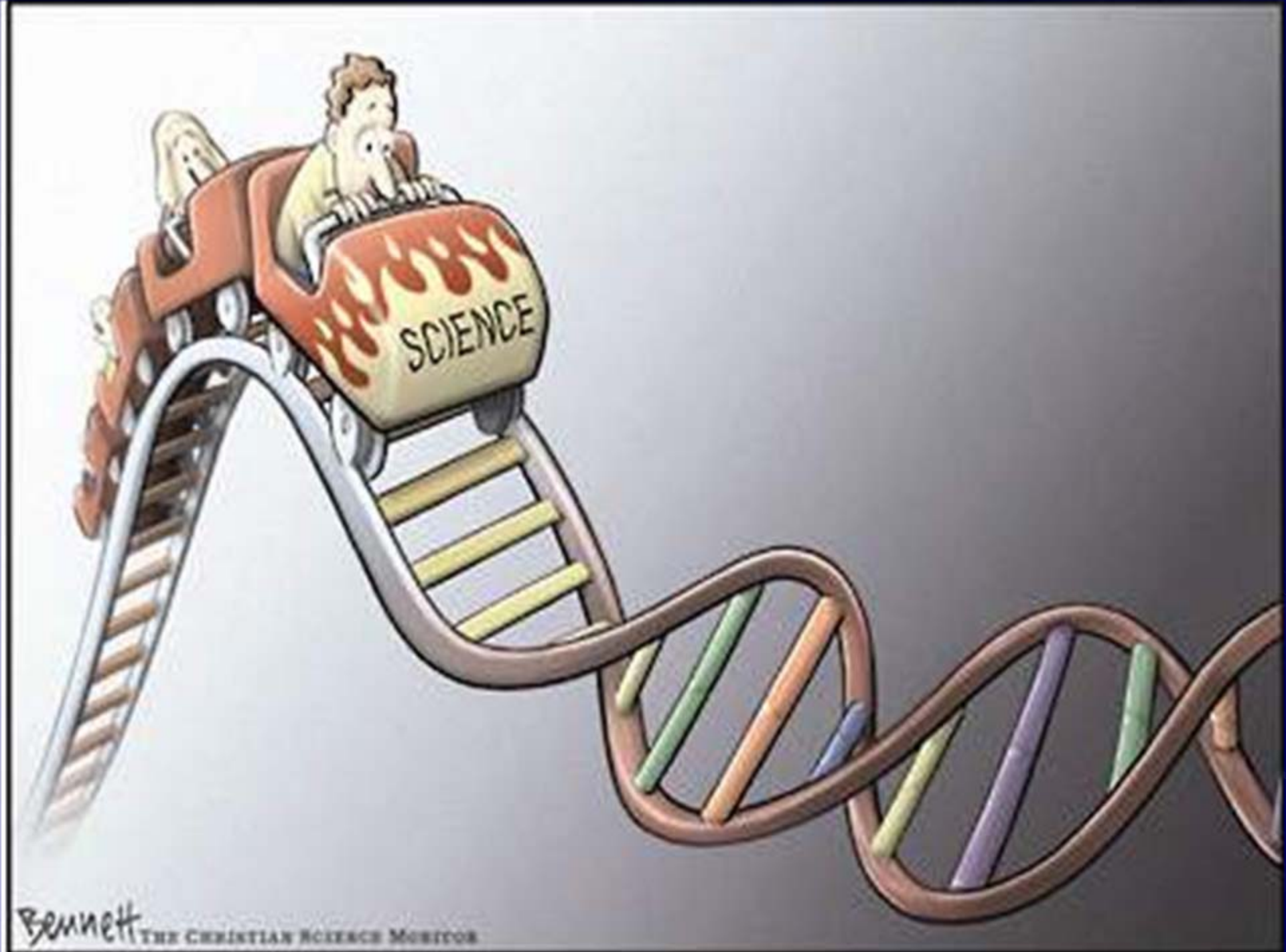
	PRODUCTION						MATERNAL					CARCASS				ULTRASOUND			\$VALUES			
	CED	BW	WW	YW	YH	SC	CEM	Milk	MW	MH	\$EN	CW	Marb	RE	Fat	IMF	RE	Fat	\$W	\$F	\$G	\$B
<b>Current Sires<sup>1</sup></b>	+5	+2.3	+39	+73	+4	+32	+6	+19	+32	+5	+7.34	+5	+14	+14	-0.001	+08	+18	+003	+22.54	+17.25	+13.70	+29.15
<b>Main Sires</b>	+5	+2.3	+42	+78	+3	+37	+6	+20	+35	+5	+5.93	+6	+16	+15	+0.000	+08	+17	+004	+23.45	+21.79	+12.63	+30.19
<b>Supplemental Sires</b>	+5	+2.0	+43	+80	+4	+41	+7	+22			+3.50	+7	+23	+21	-0.001	+15	+30	+006	+24.58	+23.40	+14.91	+34.54
<b>Current Dams<sup>1</sup></b>	+3	+2.4	+35	+63	+4	+19	+5	+17	+31	+5	+11.12					+04	+08	+002	+20.77	+9.86	+12.48	+22.73
<b>Non-Parent Bulls</b>	+5	+2.3	+40	+74	+4	+32	+6	+20			+6.01					+13	+22	+005	+23.48	+19.07	+14.61	+32.28
<b>Non-Parent Cows</b>	+5	+2.3	+40	+74	+4		+6	+20			+6.34					+15	+24	+005	+23.39	+18.51	+14.92	+32.43

<sup>1</sup>at least one calf recorded in herd book within the past two years

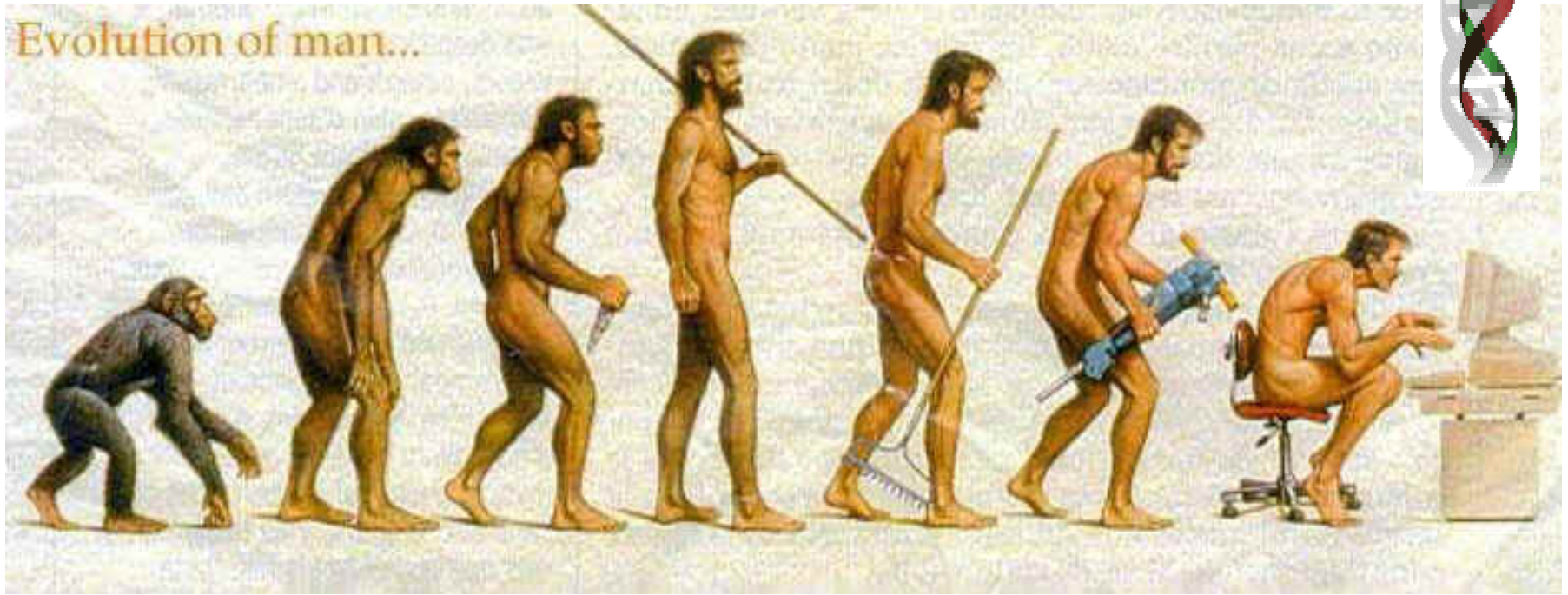
**American Angus Association<sup>SM</sup>** 3201 Frederick Ave. St. Joseph, MO 64506

**Contact us:** phone 816.383.5100 fax 816.233.9703 **e-mail**

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# We Are Entering Major Transition

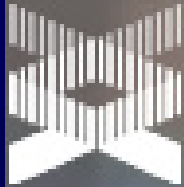


<http://www.naute.com/images/evolutionofman.jpg>



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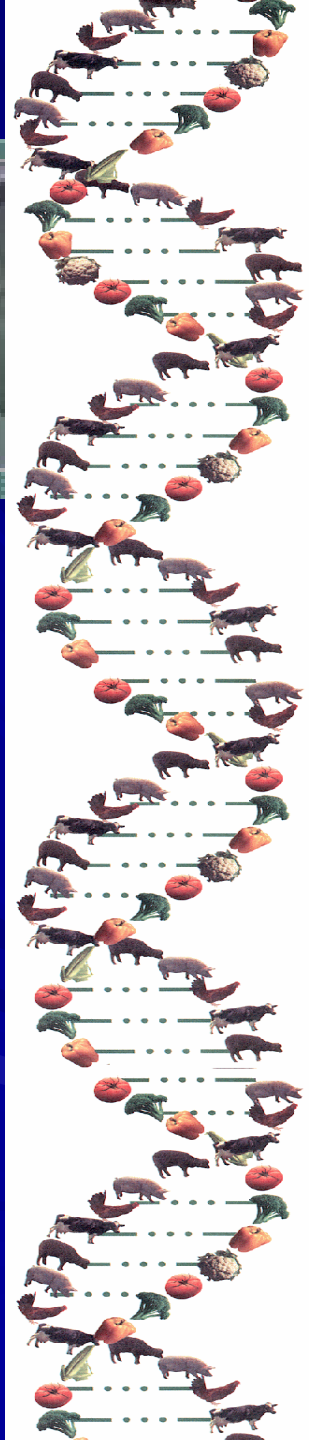
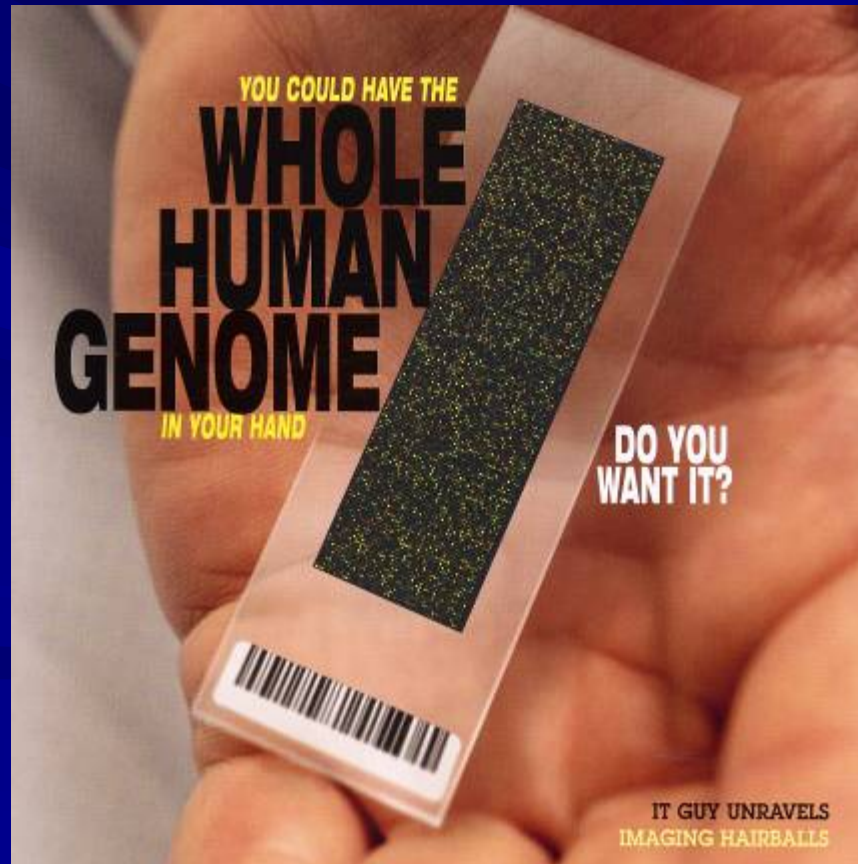
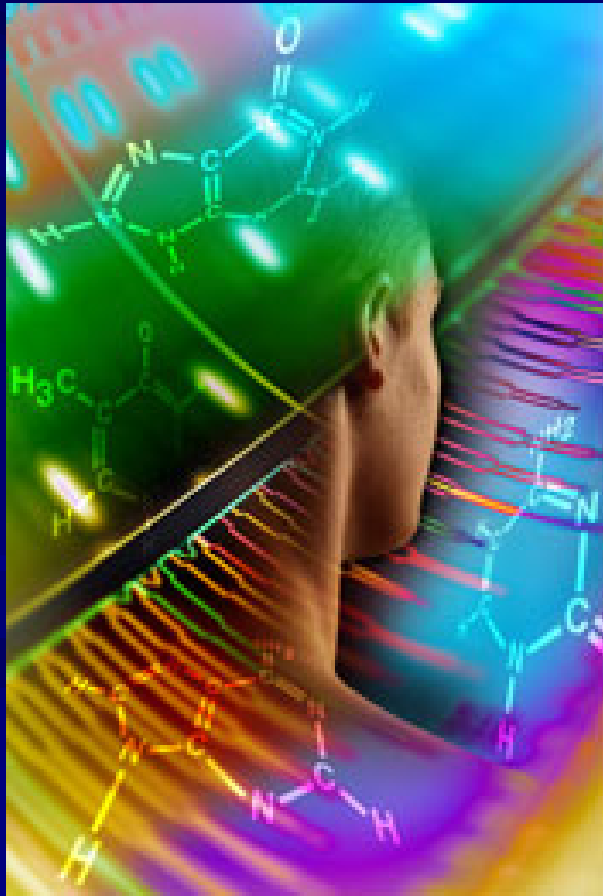
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genome.gov

# National Human Genome Research Institute

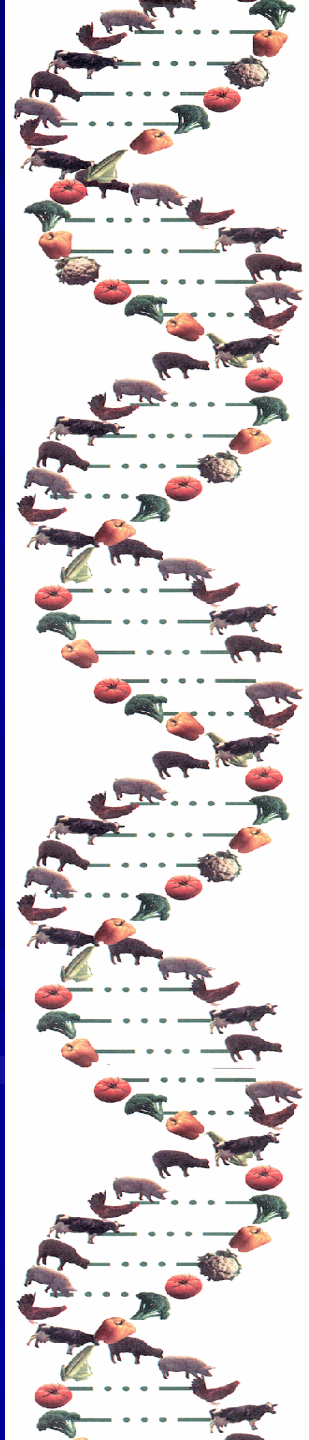
*National Institutes of Health*



2005



2004



2007

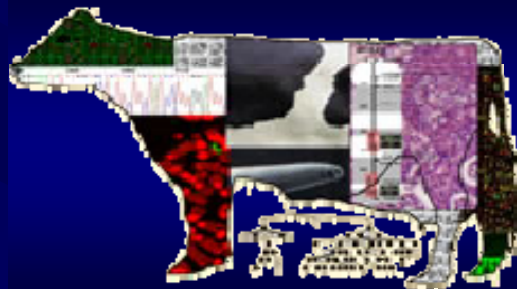


2007



2008-9





# USDA BARC and MARC

## Collaborators: Taylor and Moore

USDA United States Department Of Agriculture Agricultural Research Service

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## News & Events



The high-capacity DNA sequencer being loaded by geneticists Curt Van Tassel (left) and Tad Sonstegard will increase the number of genetic markers available for screening in livestock populations. Click the image for more information about it.

Cutting test costs while increasing the rate of genetic improvement in dairy cattle could help make the U.S. germplasm industry even more competitive in the world market, according to [Curt Van Tassel](#). He's a geneticist working with the ARS Bovine Functional Genomics Research Unit and the ARS [Animal Improvement Programs Laboratory](#), both in Beltsville, Md.

Records on performance and conformation are combined with pedigree information using sophisticated statistical methods to determine the genetic merit of animals used for breeding. But Van Tassel and ARS collaborators [Tad Sonstegard](#) and [George Wiggans](#) are investigating an approach called "genome-enhanced selection" which could replace progeny testing and cost around \$500 per bull.

### New Technique to Tap Bulls for Breeding

By [Jan Suszka](#)  
August 24, 2006

A project involving Agricultural Research Service (ARS) and collaborating scientists could open the door to a new, genomics-based approach to identifying elite bulls.

Now carried out by the artificial insemination (AI) industry, progeny testing characterizes the genetic merit of a bull. But progeny testing is time-consuming and expensive. Each year, AI organizations test 1,200 Holstein dairy bulls at a cost of about \$30 million.

to 10,000 samples.

## Illumina to Develop Bovine BeadChip, Plans to Market It in Early 2007

[August 24, 2006]

By a [GenomeWeb staff reporter](#)

NEW YORK (GenomeWeb News) – Illumina today said it plans to develop a new multi-sample bovine BeadChip and sell it early next year.

SNP content will be developed with scientists at the US Department of Agriculture's Agricultural Research Service, the University of Missouri-Columbia, and the University of Alberta.

The content will use data from the draft sequence of the cow genome and recent genome assembly done at the Baylor College of Medicine. The partners will use the SNP markers to do quantitative trait loci and to selectively breed cattle, Illumina said.

Illumina plans to offer the bovine BeadChip as a new product in early 2007 as a standard catalog array after it analyzes the initial batch of samples.

The researchers will select the SNPs after using Illumina's Infinium assay to genotype more than 10,000 cattle samples representing at least 13 different breeds, Illumina said.

Welcome, [ronnie.green@ars.usda.gov](mailto:ronnie.green@ars.usda.gov)

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Pathway Studio®  
Pathway Analysis Software

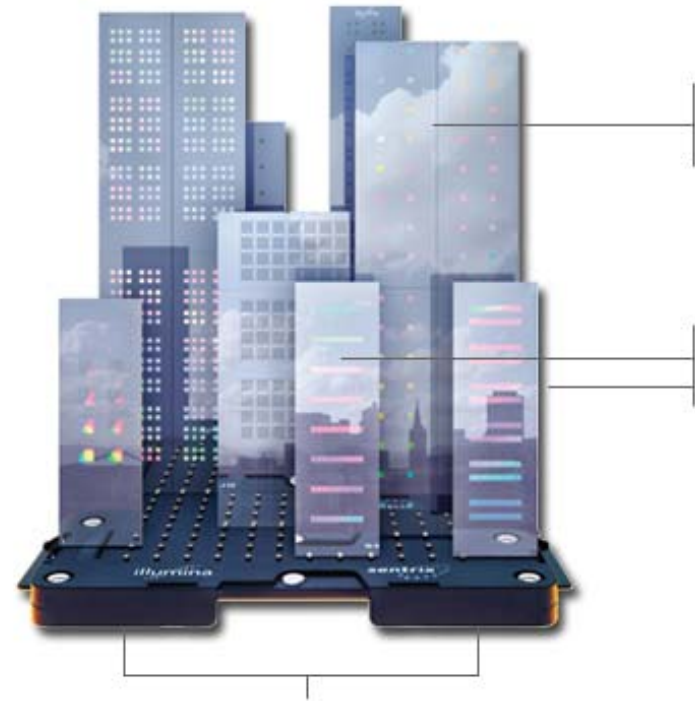
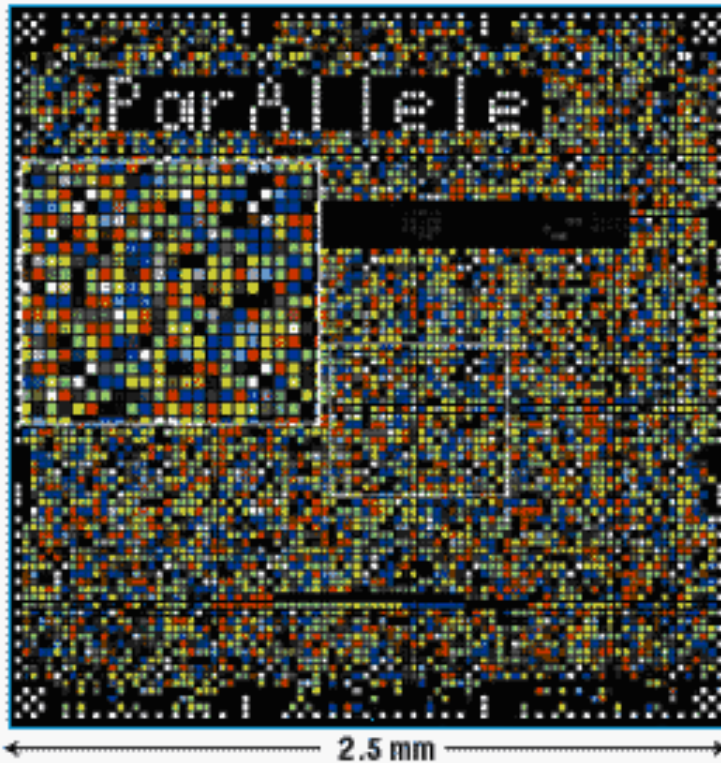
Pathway Studio is your "next step" after microarray analysis and more.

- Interpret microarray and proteomics data
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# Cost effective whole genome SNP genotyping ...50K, 300, 500, 1000+



***“Layers of customization”***



# ... to whole genome methods....

Cost-effective whole genome  
SNP genotyping

+

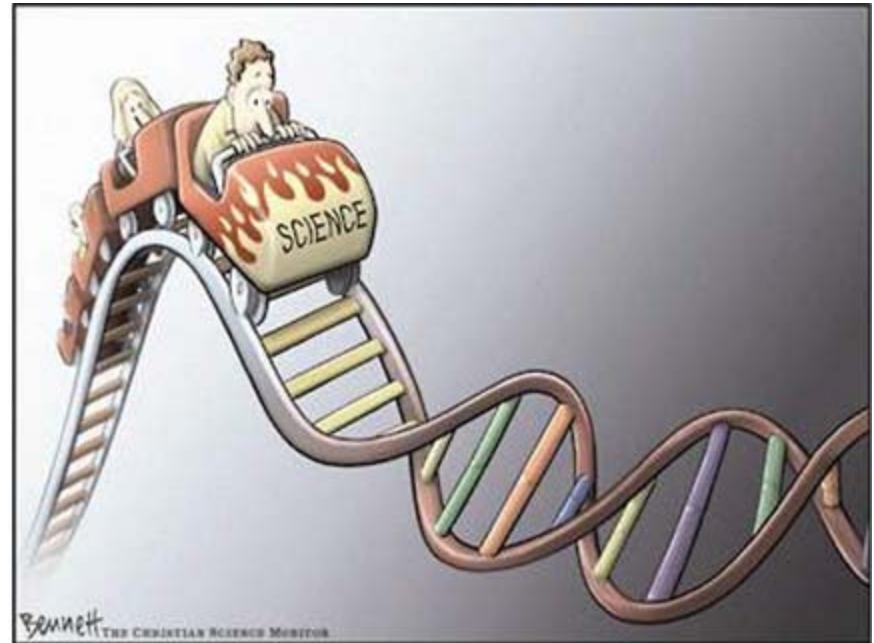
Long-range LD in livestock

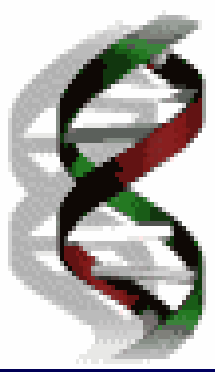
+

Advanced statistical genetics  
(e.g. Meuwissen & Goddard)

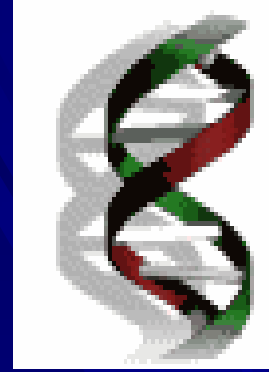


## Genomic selection





# Genetic Improvement -- SNP Based Whole Genome Selection



Unknown genes

Molec. genetics

TagSNP

Phenotypic data

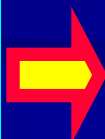
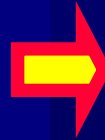
EPD for unknown polygenes

*“Haplotype” BLUP*

“Genome Enhanced” Selection criterion

SNP Genotypes

(E)PD for identified Haplotypes



# Initial USDA-ARS / CDDR Results

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- Increase in reliabilities in ranging from 15-38%
- Realized  $h^2$ 's averaged 23% higher for genome-enabled predictions above parent averages (~11 daughter records)



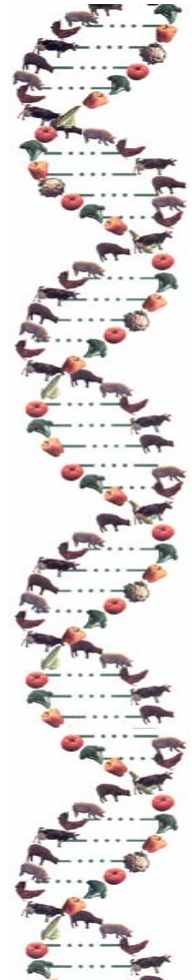
*Source: VanRaden et al. 2008*

# Additional applications.....

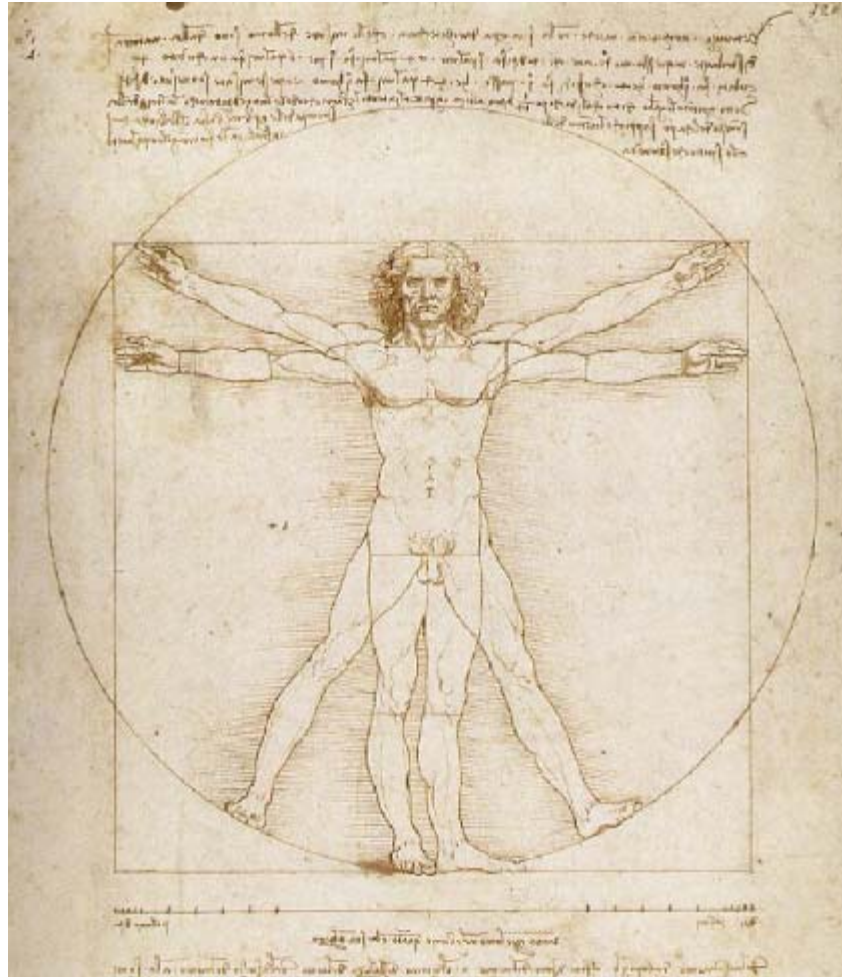


The screenshot shows the USAIP Information Site. On the left is a logo for the United States Animal Identification Plan (USAIP) featuring a map of the United States with the text "United States USAIP" and the tagline "Protecting American Animal Agriculture". On the right, there are images of various farm animals including a llama, bison, cow, pig, horse, deer, sheep, chicken, and fish. Below the images is the text "United States Animal Identification Plan (USAIP) Information Site" and "Click on animal to view proposed USAIP Plan under development." At the bottom of the screenshot is a navigation bar with links: USAIP Home, Resources, Questions?, Work Plan, and Send Comments.

- *Trait Prediction*
- *Traceability / Animal ID*
- *Parentage*
- *Allele-sharing (M-inverse)*

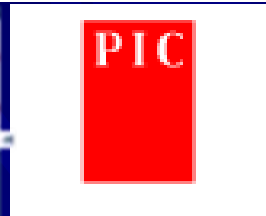


# Animal Genetics Renaissance !!



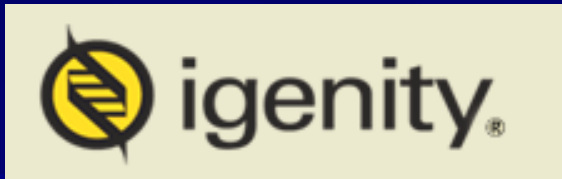
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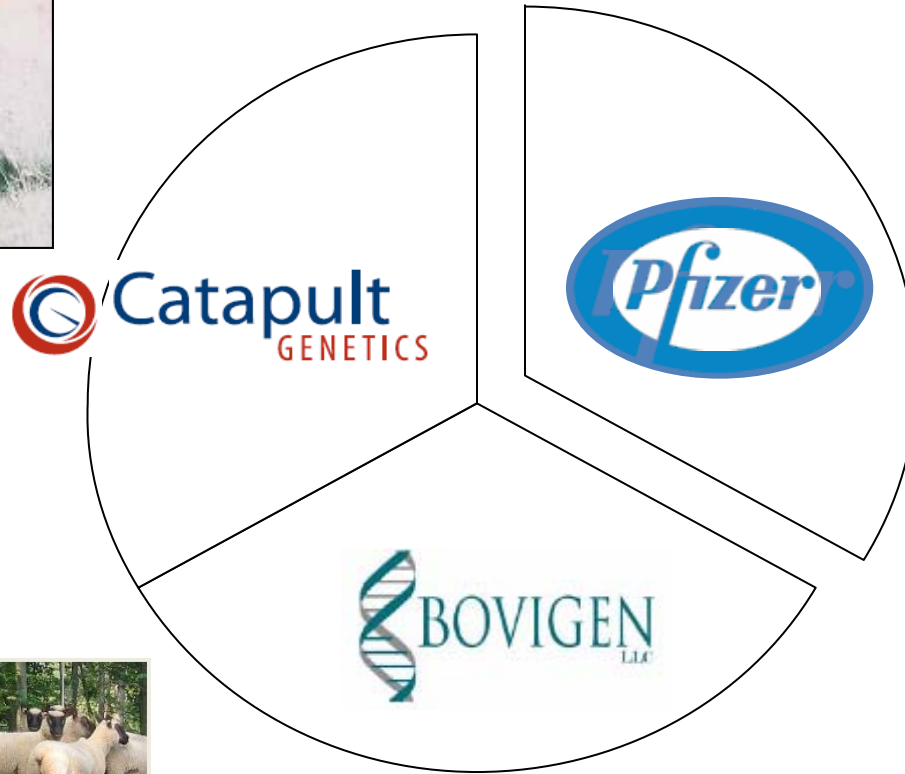


SAVAGE, Md. and MINNEAPOLIS - June 11, 2002

MetaMorphix signs deal to develop genetic selection tool using cattle genome -- *Exclusive agreement with Cargill's Caprock Cattle Feeders and Excel Corporation expected to result in superior beef for consumers*



# Pfizer Animal Genetics



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# Pfizer Animal Genetics Global Vision



***Revolutionizing the Livestock Industry through Integrated Genetic Solutions.***

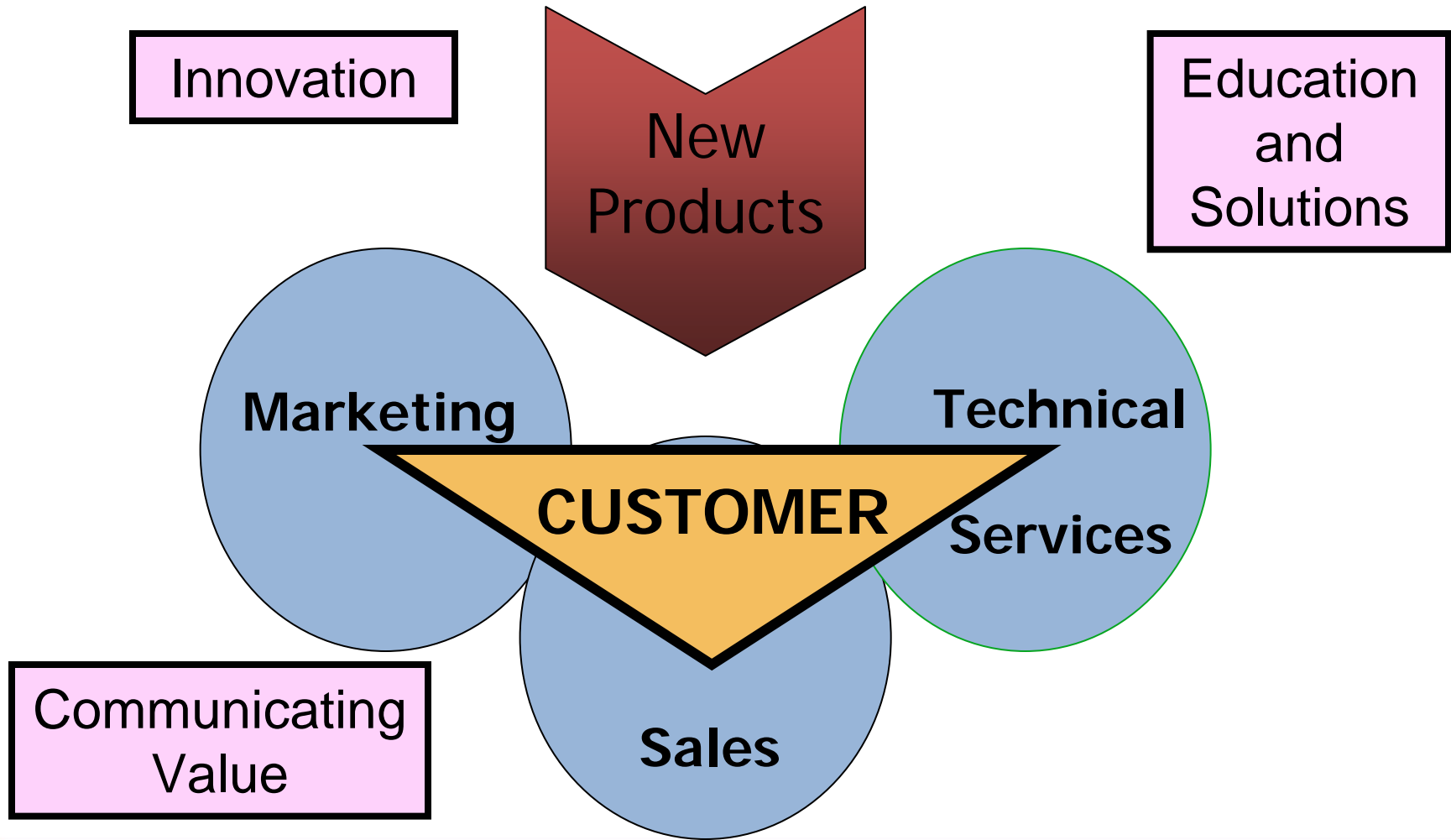
***Best Science, Best Support, Best Value.***

***"FULL SERVICE GENOMICS PROVISION"***

# Pfizer's Commitment to the Industry

- Invest in the best global research
- World class internal product development
- Develop tools to meet customer needs
  - We are listening to learn
- Demonstrate and communicate value
  - **Validation studies (= Phase 3b and 4)**
  - **Technical support**
  - **Develop solutions**
- Chart a way forward based on strategic partnerships

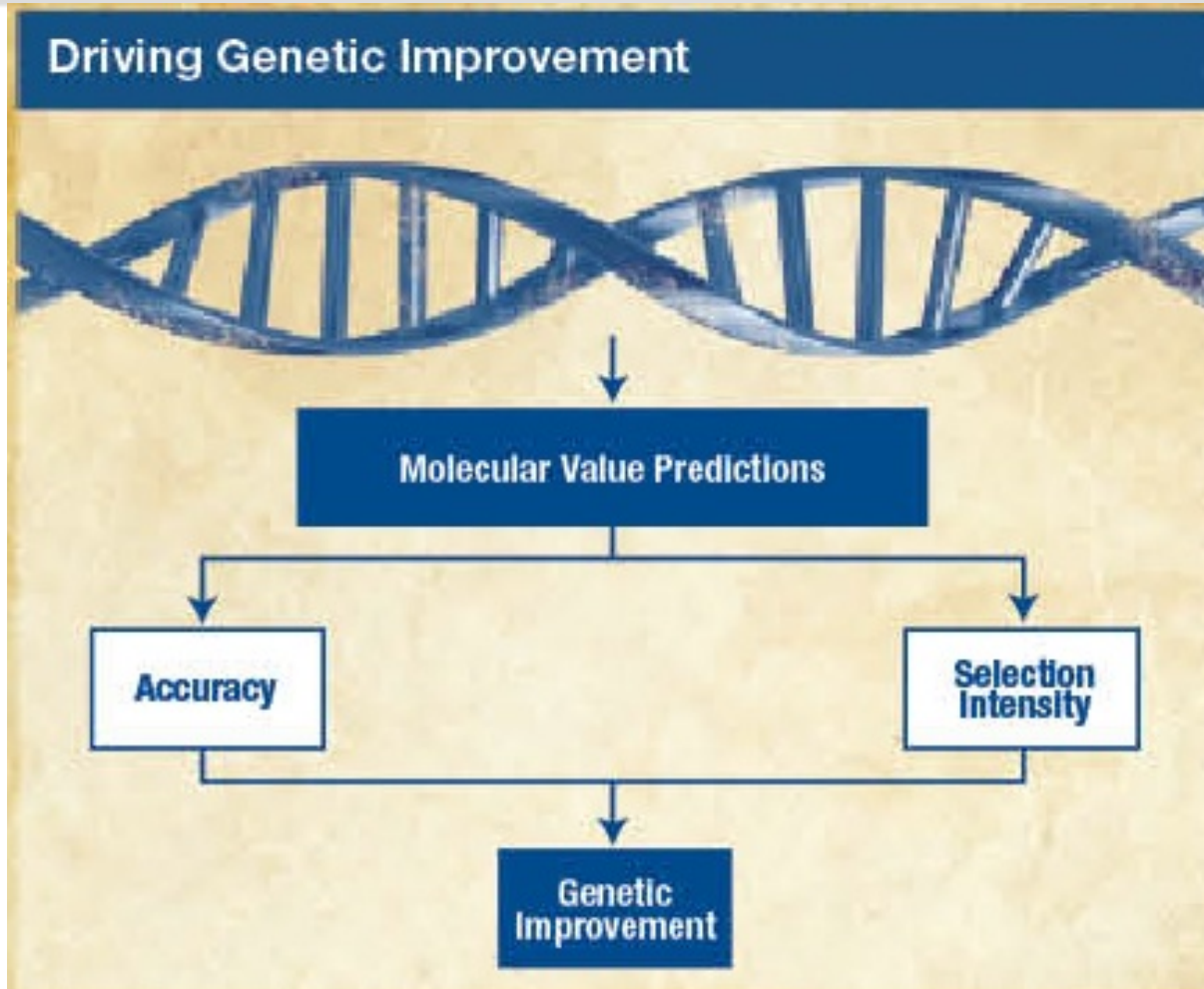
# Delivering full service genomics..



# .....Evolving Products.....

- Moving away from individual markers toward panels
- Predicting merit not simply number of stars
- Predictions for genetic improvement or phenotype
- Markers with large effects less common
- Markers with effects on multiple traits
- Economic return needs to be evaluated
- Combining different sources of information (EBV, EPD, markers)
- Implementation beyond test results for seedstock breeders – *“solutions beyond data”*

# Driving Genetic Improvement



# External Validation

- Designed to confirm relationships between genomic predictions and performance
- Used to confirm % genetic variation described by genomic predictions
- Globally



The Cooperative Research Centre for  
Beef Genetic Technologies

University of  
NEW ENGLAND

*National* Colorado State University-Cornell University-University of Georgia-Iowa State University  
**Beef Cattle Evaluation**  
*Consortium*

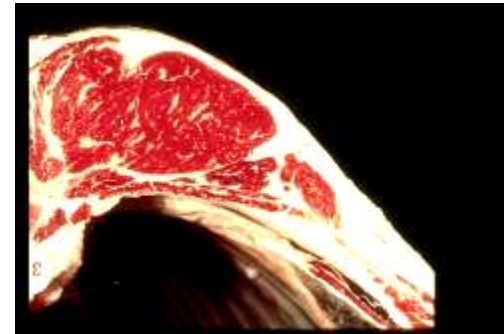
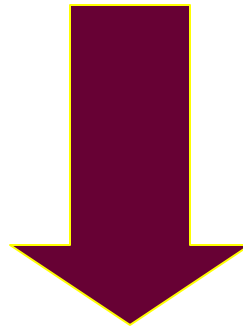
# Investing in the Future....



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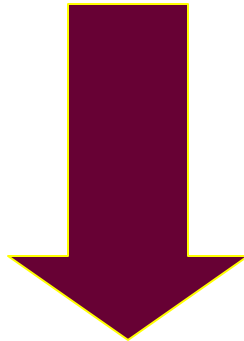
# Genomic Predictions for What Traits?



- ❖ Feed Efficiency
- ❖ Feedlot Health Index
- ❖ Postweaning Gain Growth Curve Parameters
- ❖ Temperament Index
- ❖ Days to Spec
- ❖ Immunocompetence Index

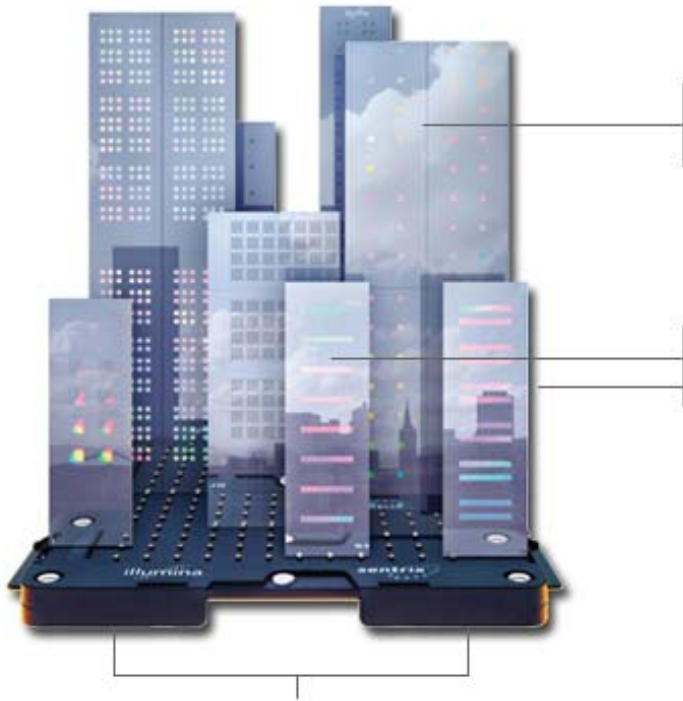
- ❖ Ribeye Area
- ❖ Carcass Weight
- ❖ % Red Meat Yield
- ❖ Marbling/IMF
- ❖ Tenderness (Trustmark)
- ❖ Fatty Acid Index
- ❖ Healthfulness Index

# Genomic Predictions for What Traits?



- ❖ Heifer Fertility
- ❖ Cow Maintenance Efficiency
- ❖ Stayability (Survivability)
- ❖ "Fleshing Ability"
- ❖ Calving Ease
- ❖ Bull Fertility / Libido
- ❖ *Cow Herd Profitability Index*

# Pfizer's Commitment to the Industry....



$$\begin{array}{r} \underline{20,000} \\ \times \\ \underline{50,000 \text{ (or more)}} \\ \times \\ \underline{\$ \$} \end{array}$$



# Products in the Era of the Genome

- Nucleus Level / AI Organization
  - 50K (likely more) analysis
  - Full trait profile and prediction
- Seedstock Producer
  - 1-2K analysis
  - Majority of traits with prediction
- Commercial Cow/Calf Producer
  - Few hundred markers
  - Focus on cow profitability
- Feedlot Performance / Supply Chain Prediction
  - Few hundred markers
  - Focus on feedlot performance & health

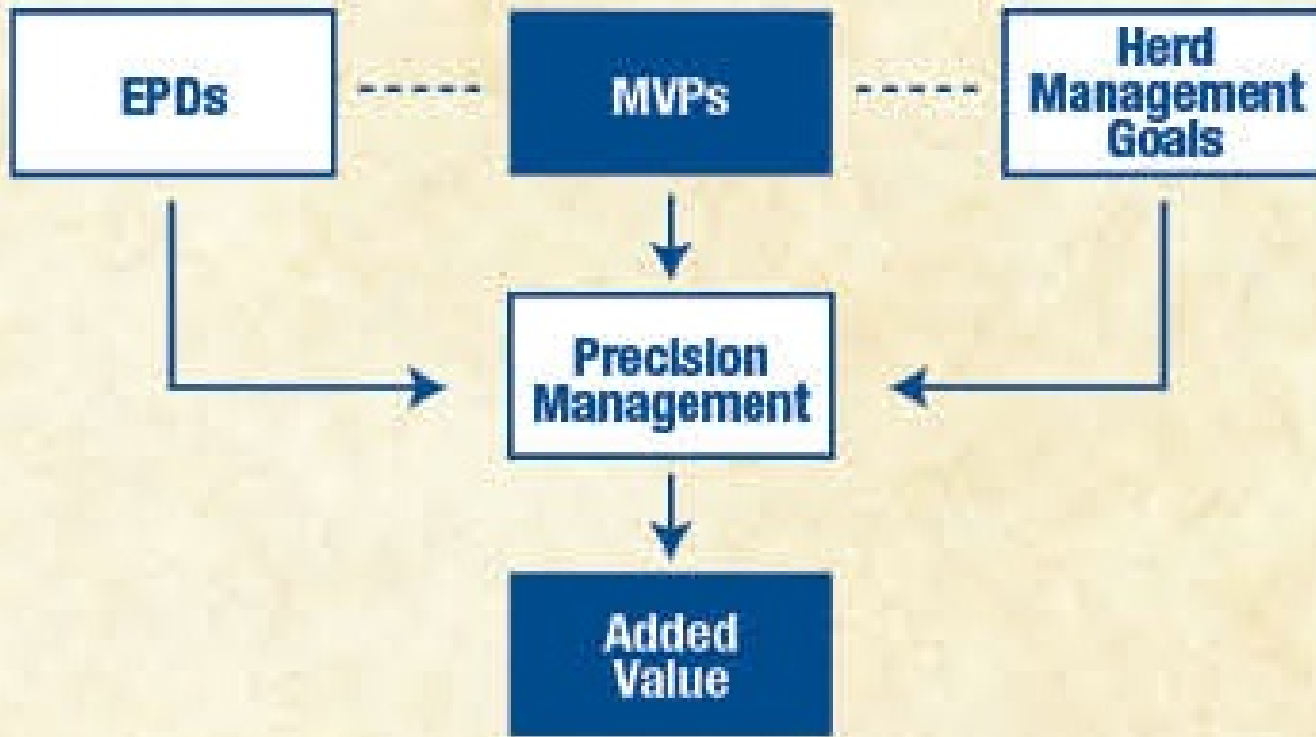


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# All Things in Balance

## Delivering Added Value



# “Common Sense Interdependencies”



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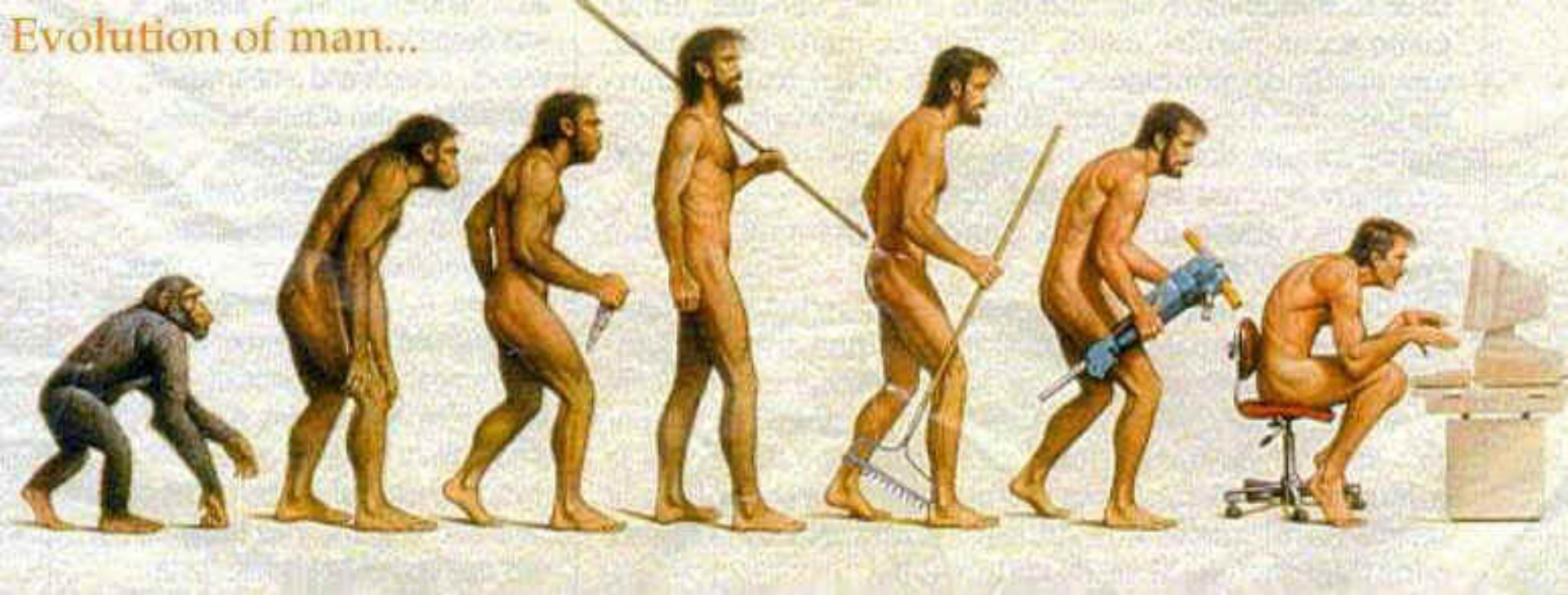
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# Blending Sources of Information



- Blended EPD's combining EPD and genomic predictions
- 'Shrinking' of estimates based on amount & quality of information on markers
- Blending of EPD information and genomic predictions can be outside of the core genetic evaluation process or inside
- Blending can be done with information other than EPD's
- Followed by breeding program design tools

## Evolution of man...



***“We all can see the ultimate end game now  
much more clearly with  
the new technology platforms –  
but how we lead the transition to get there  
from here will define our legacy.”***



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