Animal Biotechnology:
Where to from here?

Alison Van Eenennaam, Ph.D.
Cooperative Extension Specialist
Animal Biotechnology and Genomics
University of California, Davis
alvaneenennaam@ucdavis.edu

7/11/2007

Animal biotechnology

(Application of science and engineering to animals)

- Artificial selection (breeding programs)
- Artificial Insemination
- Hormone use
- Using DNA information for the marker-assisted selection of superior animals
- Genomics
- Cloning
- Genetic engineering

"The public opposes animal biotechnology.."

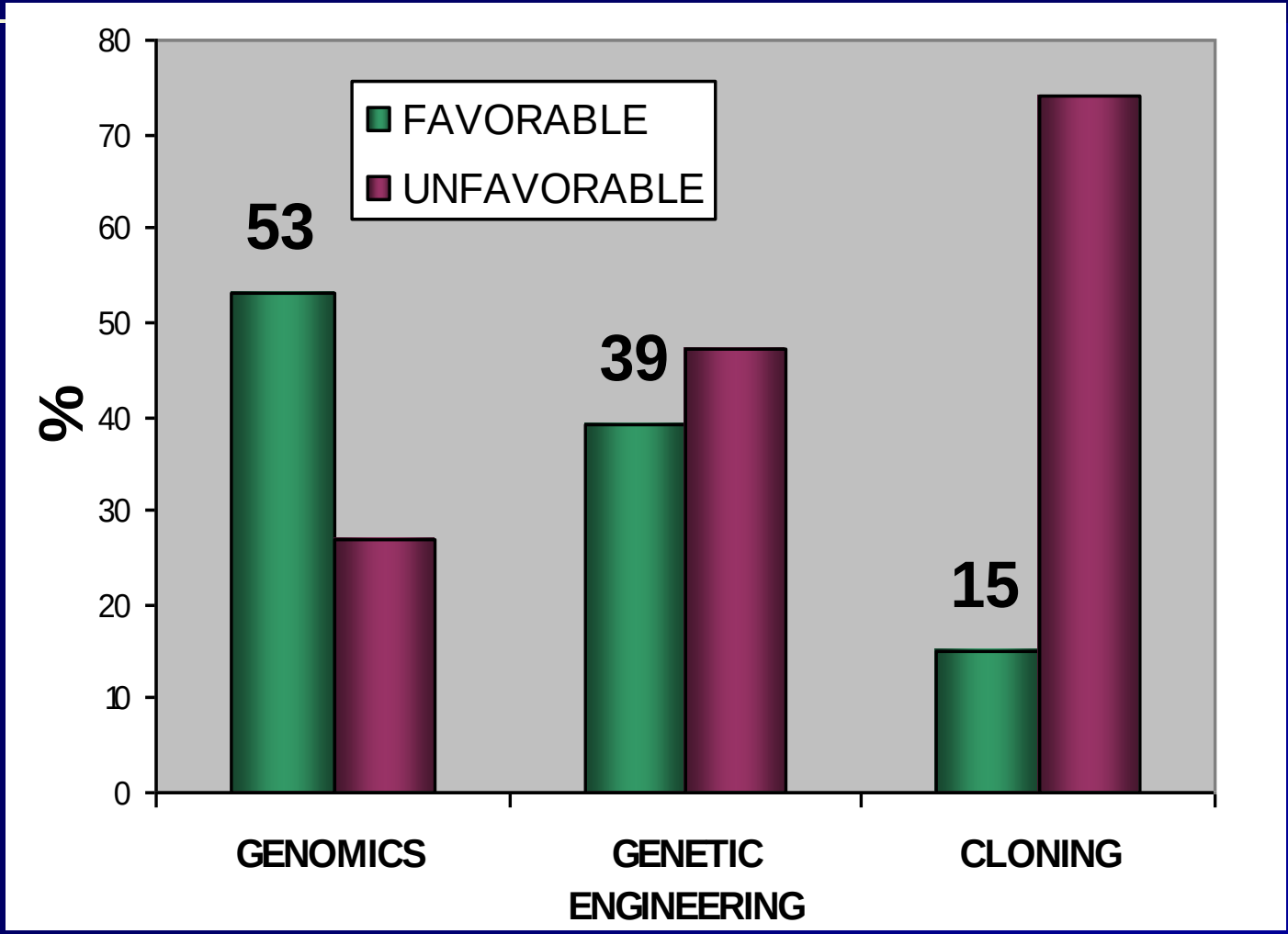
- The majority (56%) of Americans oppose scientific research into genetic modifications of animals.

http://pewagbiotech.org/research/2005update/2005summary.pdf

- In a survey of New Jersey consumers, Hallman found that two-thirds of respondents disapproved of traditional animal crossbreeding techniques and half found them "morally wrong".

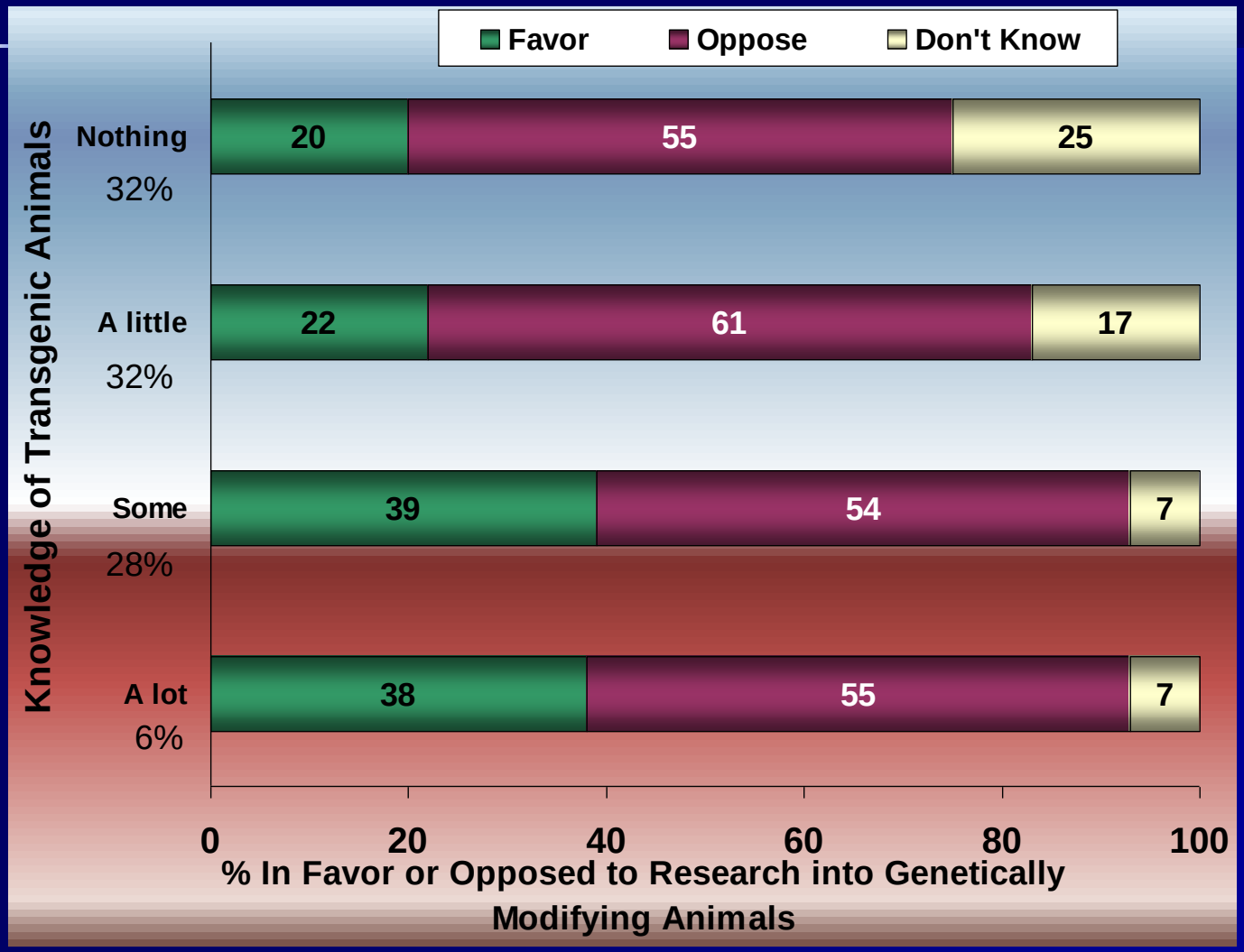
Schilling, B. J., Hallman, W. K., Adelaja, A. O., and Marxen, L. J.2002. *Consumer Knowledge of Food Biotechnology: A Descriptive Study of U. S. Residents*. Food Policy Institute, Cook College, Rutgers - The State University of New Jersey. 25p. http://www.foodpolicyinstitute.org/

Public Attitudes Towards Specific "Animal Biotechnologies" (IFIC, 2005)



http://ific.org/research/upload/2005BiotechSurvey.pdf

The majority of Americans oppose scientific research into genetic modifications of animals - irrespective of self-assessed knowledge level



10/2005

http://pewagbiotech.org/research/2005update/2005summary.pdf

It may be difficult to know what the public has heard about animal biotechnologies….

Supercow and pigs that glow at night - an average day on the GM farm

Last updated at 10:11am on 3rd November 2006

Channel 4 is to unveil a shocking menagerie of genetically modified animals in a new show revealing the frightening leaps technology has taken.

Appliance of science: the Belgian Blue is bred to produce gallons of milk

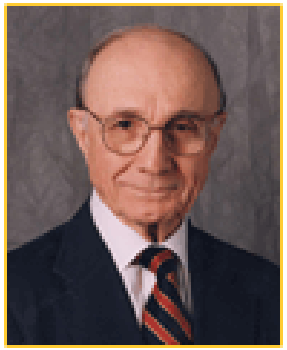
Among the bizarre engineered creatures from around the world is a giant cow, three times the size of ordinary cattle, reared without fat to produce gallons of milk.

But the so-called Belgian Blue - pictured

The President's Council on Bioethics

Advising the President on ethical issues related to advances in biomedical science and technology

"To advance human good and avoid harm, biotechnology must be used within ethical constraints. It is the task of bioethics to help society develop those constraints and bioethics, therefore, must be of concern to all of us."
Chairman's Bio



Edmund D. Pellegrino
Chairman

Topics of Council Concern

Age-Retardation (Life Extension)

Aging and End-of-Life

Beyond Therapy (Enhancement)

Biotechnology and Public Policy

Bioethics in Literature

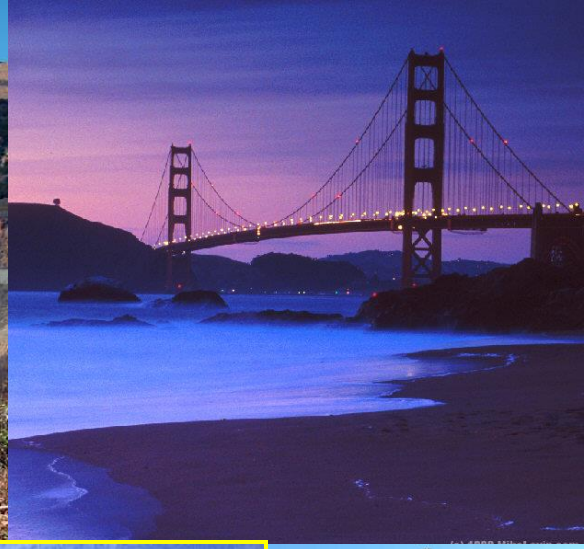
Cloning

What's New...

Stem Cell Research Check for updates on adult, embryonic, and alternative sources of human pluripotent stem cells.

http://www.bioethics.gov/



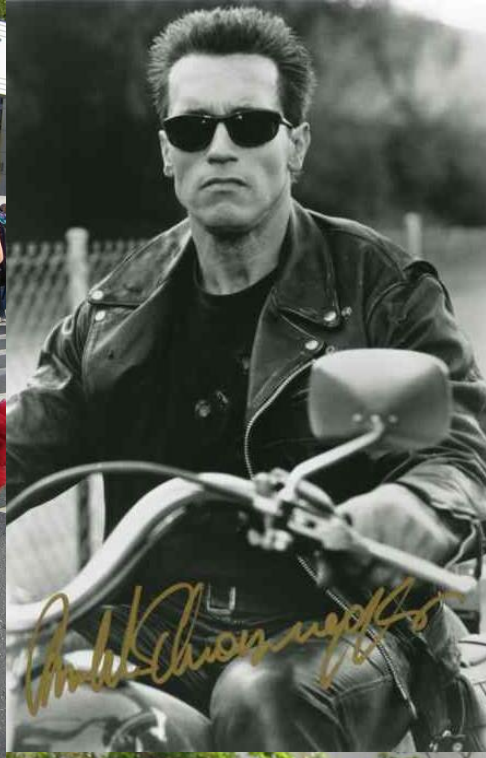




HOLLYWOOD

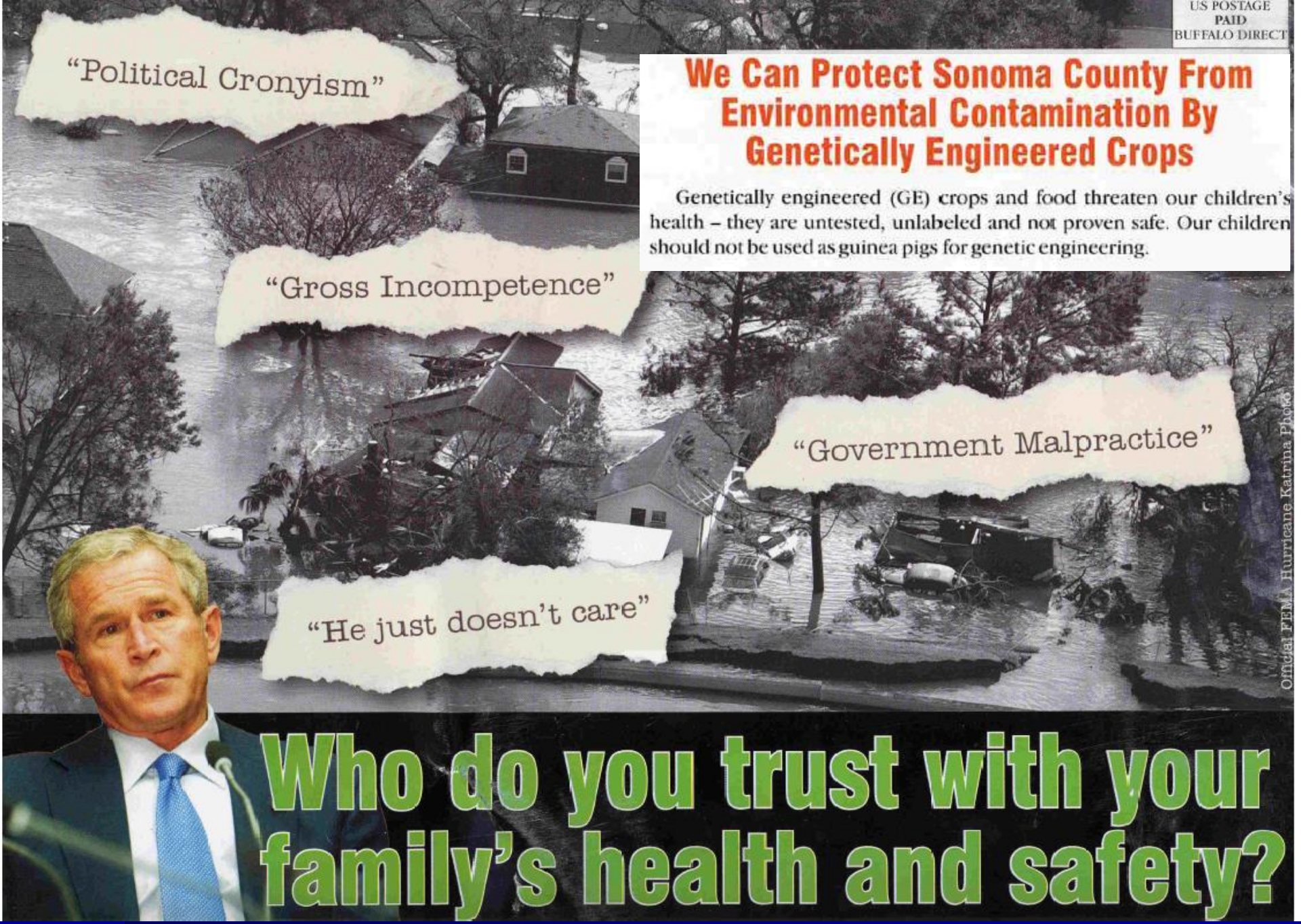


MOSCONE
21853
12757




Thing
#4


ANTI-GMO ORDINANCES PASSED
ANTI-GMO ORDINANCE VOTED ON AND REJECTED, NOVEMBER 2004/2005
ANTI-GMO ORDINANCES UNDER CONSIDERATION
PRO-GMO RESOLUTION PASSED
Green outline denotes major GE-crop growing areas
DEL NORTE
SISKIYOU
MODOC
HUMBOLDT
TRINITY
SHASTA
LASSEN
TEHAMA
PLUMAS
MENDOCINO
GLENN
BUTTE
SIERRA
NEVADA
LAKE
COLUSA
SUTTER
YUBA
PLACER
EL DORADO
Sacramento
YOLO
SONOMA
NAPA
SACRA-MENTO
AMA-DOR
ALPINE
SOLANO
CALAVERAS
SAN FRANCISCO
MARIN
CONTRA COSTA
SAN JOAQUIN
TUOLUMNE
MONO
ALAMEDA
STANISLAUS
MARIPOSA
SAN MATEO
SANTA CLARA
MERCED
MADERA
SANTA CRUZ
FRESNO
SAN BENITO
INYO
MONTEREY
TULARE
KINGS
SAN LUIS OBISPO
KERN
SAN BERNARDINO
SANTA BARBARA
VENTURA
LOS ANGELES
Los Angeles
RIVERSIDE
ORANGE
SAN DIEGO
IMPERIAL



We Can Protect Sonoma County From Environmental Contamination By Genetically Engineered Crops

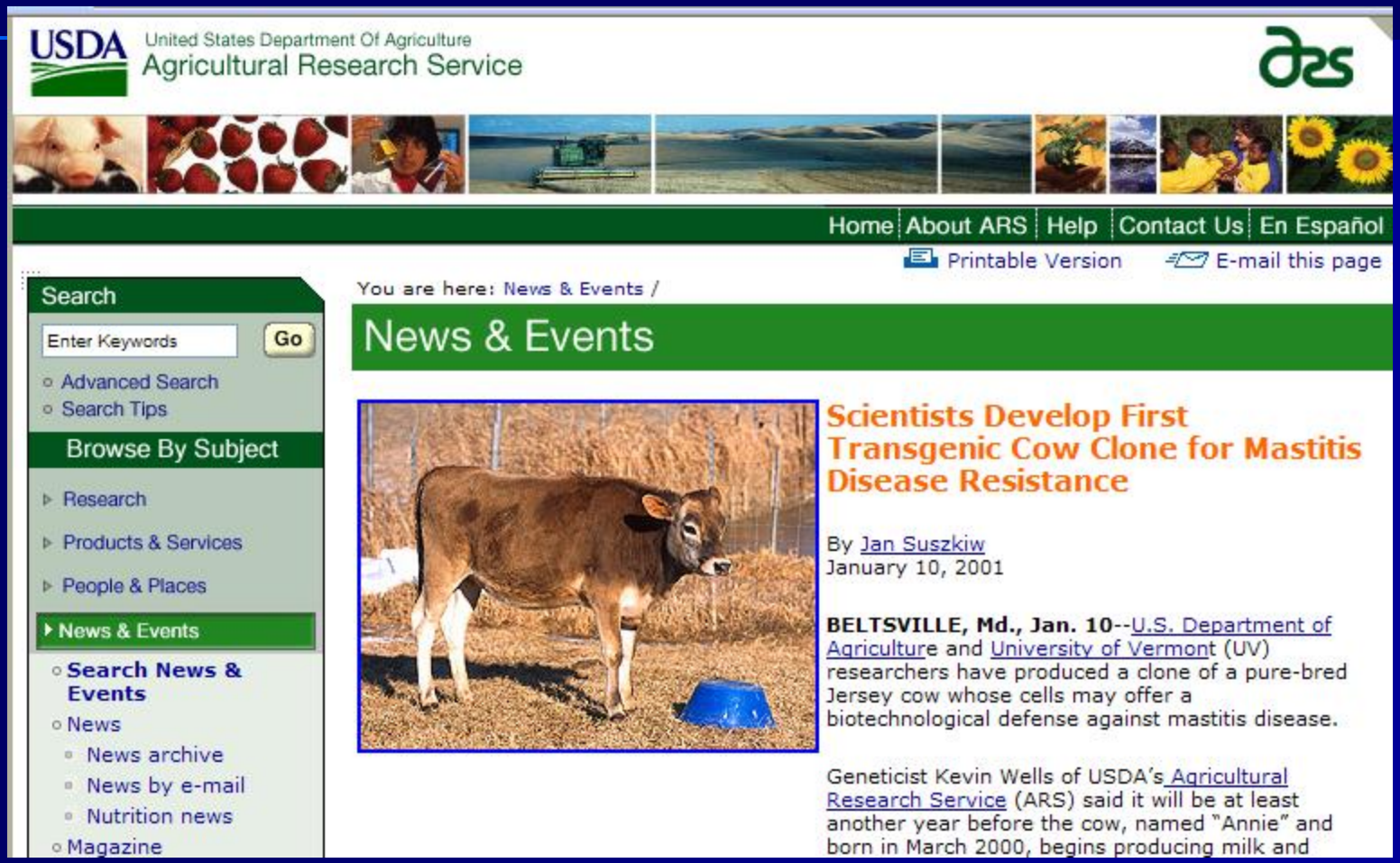
Genetically engineered (GE) crops and food threaten our children's health – they are untested, unlabeled and not proven safe. Our children should not be used as guinea pigs for genetic engineering.

GE animals and clones raise ethical questions – not necessarily unique or to these biotechnologies

- Animal welfare
  - related to breeding goals
  - related to biotechnology
- Environmental impacts
- Animal "integrity"/telos
- Concerns that these technologies are "unnatural" and amount to "playing God"

Fish genes in strawberries?

Transgenic cows expressing an antibacterial endopeptidase in their mammary glands show enhanced resistance to mastitis.



Wall,R.J. *et al.* 2005. **Genetically enhanced cows resist intramammary Staphylococcus aureus infection.** *Nature Biotechnology* **23**, 445-451.

Enviropig™ (Low-phosphorus manure) http://www.uoguelph.ca/enviropig/

Golovan,S.P., et al. 2001. **Pigs expressing salivary phytase produce low-phosphorus manure.** *Nature Biotechnology* **19**, 741-745 (2001).

Transgenic pigs constitutively expressing an omega-3 fatty acid desaturase.

HEALTH & SCIENCE

Making Bacon That's Healthier for You

Listen by Joe Palca

Steve Morse/University of Missouri Extension and Agricultural Information

These pigs carry a gene that helps their bodies produce a healthier fat, known as omega-3 fatty acid.

NPR.org, March 26, 2006 · If you think scientists never do anything useful, consider this: A team of researchers may have found a way to make bacon that's good for your heart. This stunning achievement comes from a mixture of molecular genetics, cloning, and good old American know-how.

The key to this delicious prospect? A modified gene that changes some of the omega-6 fatty acids -- which pigs normally create -- into omega-3 fatty acids.

Omega 3 is the healthy fat you get in oily fish and flax seed. It's generally thought that a diet high in omega-3 fatty acids helps prevent heart disease.

The first animals to get this

Wall,R.J. Lai, L.X., et al. 2006. **Generation of cloned transgenic pigs rich in omega-3 fatty acids**. *Nature Biotechnology* **24**, 435-436

Clop,A., et al. 2003. **Detection of QTL affecting fatty acid composition in the pig.** *Mammalian Genome* **14**, 650-656

Nii,M., et al. 2006. **Quantitative trait loci mapping for fatty acid composition traits in perirenal and back fat using a Japanese wild boar x Large White intercross**. *Animal Genetics* **37**, 342-347.

Skim milk straight from the cow

Liz Williams
Cosmos Online

Monday, 28 May 2007

SYDNEY: A new breed of cow that produces skim milk naturally – straight from the teat – has been discovered by New Zealand scientists.

The cow's milk is low in saturated fat but high in protein, according to the researchers. It is also high in omega-3 oils, which have been linked to improved brain power and mental wellbeing, as well as decreased incidence of cardiovascular disease.

Mutant Marge

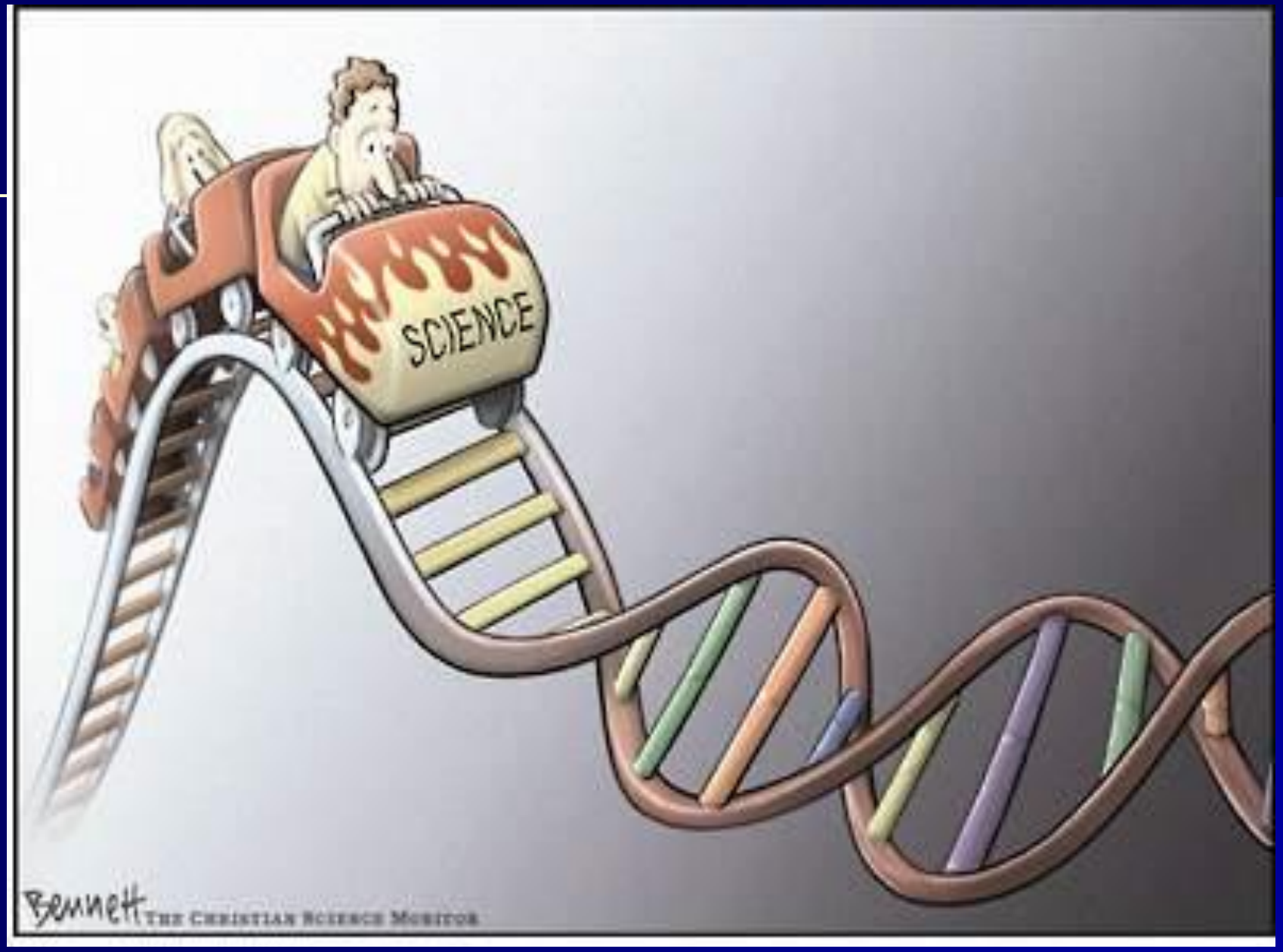
A Friesian cow called Marge is at the centre of the breakthrough. Discovered in 2001 by New Zealand-based biotech company ViaLactia, Marge has a random genetic mutation that enables her to produce milk containing significantly less fat than regular milk.

More importantly, Marge's milk also has substantially lower levels of saturated fat – a leading cause of obesity and cardiovascular disease in humans.

The researchers identified the low-fat milk in a random screening of millions of New Zealand cattle in 2001. They bought her for NZ$300 (AU$265) from

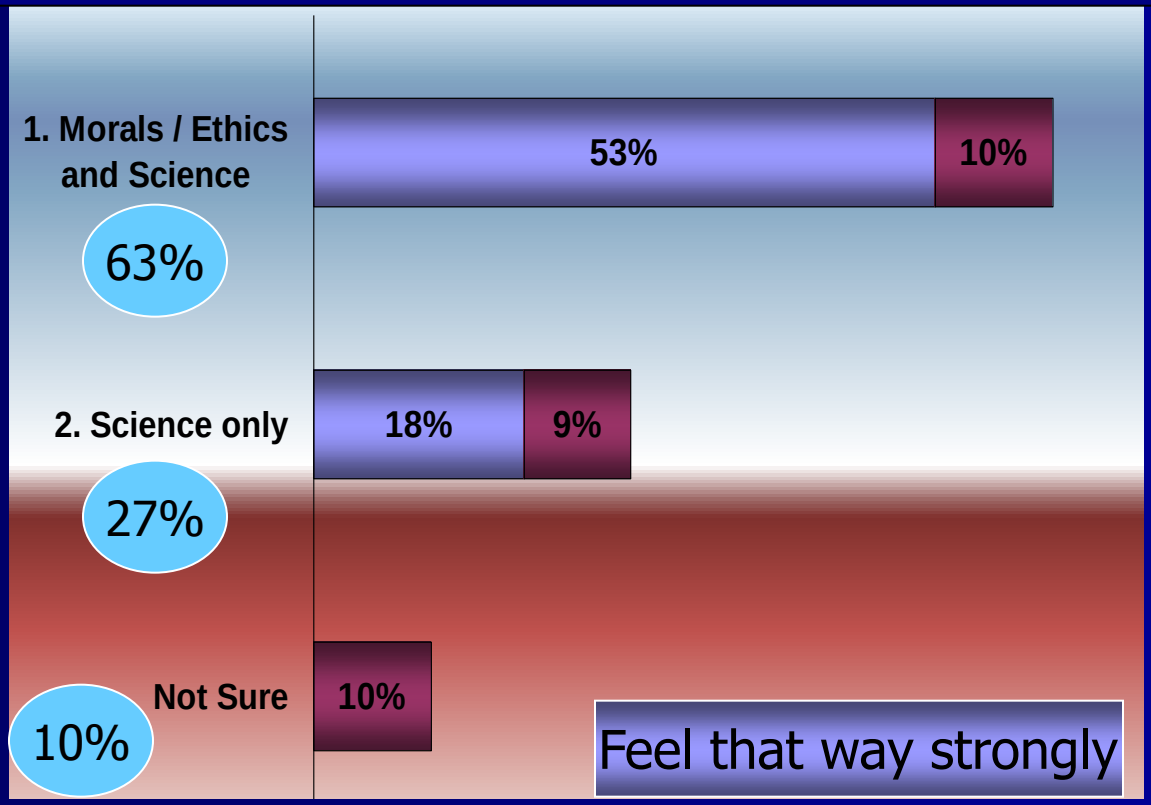
A Friesian cow that produces low-fat milk from the teat has been discovered by New Zealand scientists

Image: iStockphoto


SCIENCE
Bennett
THE CHRISTIAN SCIENCE MONITOR

1. Government regulators ***should include ethical and moral considerations***, in addition to scientific evaluation of risks and benefits, when making regulatory decisions about cloning or genetically modifying animals.

2. Though ethical and moral considerations are important, government regulators ***should consider only scientific evaluation of risks and benefits*** when making regulatory decisions about cloning and genetically modifying animals.



http://pewagbiotech.org/research/2005update/2005summary.pdf

U.S. has a science-based regulatory system

CYAGRA

PHOTO GALLERY

197 Bossler Rd, Elizabethtown, PA 17022

Livestock Cloning and Genetic Preservation

Ph: 866.783.6226

Beef Cattle | Dairy Cattle | Rodeo Stock | Swine Breeds | HOME

"Paradise" A Supreme Champion

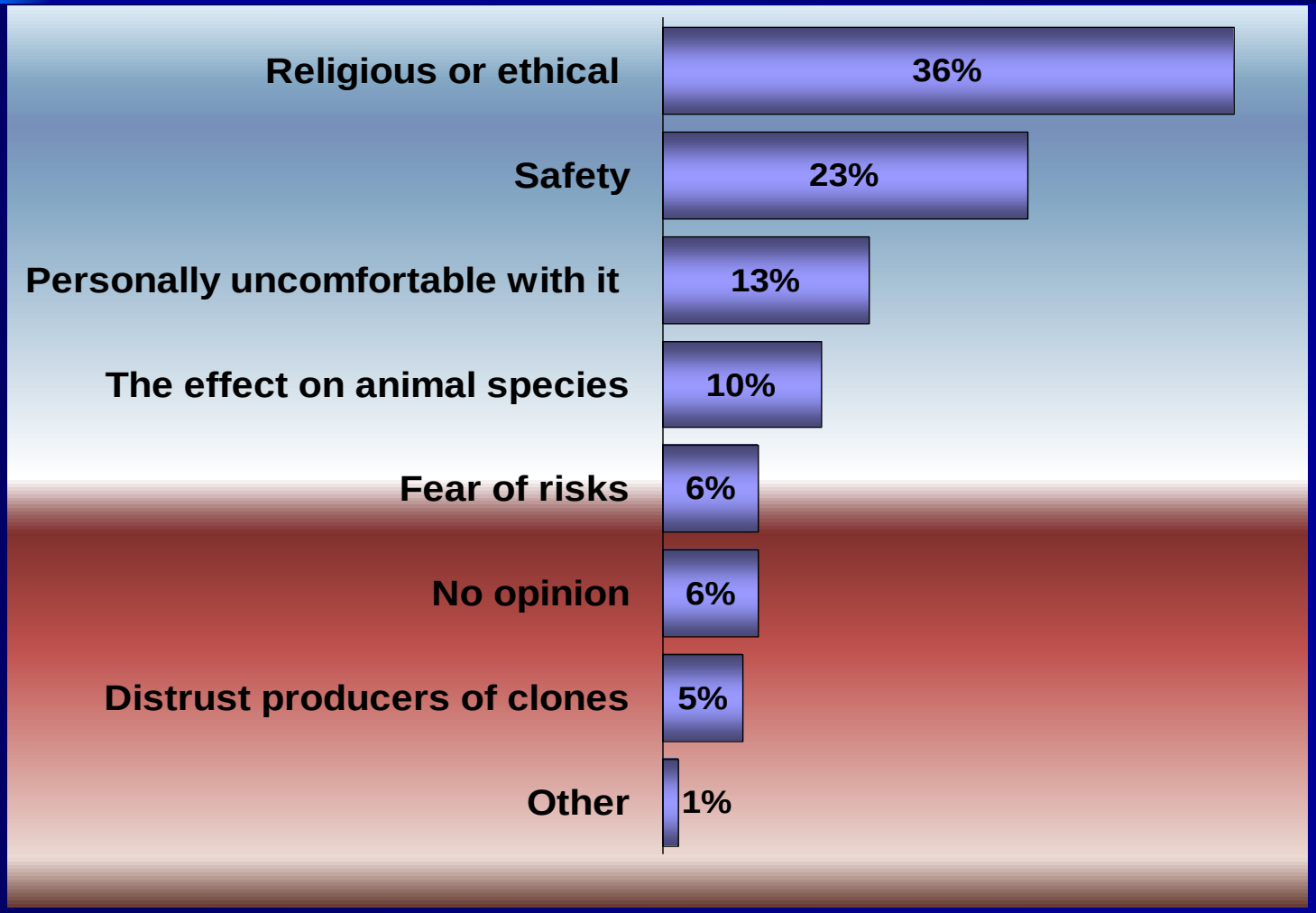
Cloning gives you the ability to realize the value of a truly great cow both from the breeding and merchandizing standpoint

Vandyk-K Integrity Paradise, the two time Supreme Champion at the World Dairy Expo, was an easy choice for her owners to clone. When you have an individual this good you need to have more copies of her to realize her true value. Cashing in on her value is just what they did when they sold a Paradise clone for $50,000. The merchandising options you get from cloning are just fantastic, because you still have the genetic material to work with.

Paradise's Clone Wins!!!

Paradise 2 Selected All-American Sr. 2 Year Old

Of the Americans who are uncomfortable or unsure about animal cloning; their primary concern is:



10/2005

http://pewagbiotech.org/research/2005update/2005summary.pdf

Animal cloning regulations in Denmark and Norway prohibit cloning for food and agricultural purposes.

"Alicia"

An International Star

Winner at the prestigious International Dairy Show in Madison, WI and at the Royal Winter Fair in Canada, Shoremar S Alicia was cloned in 2001. The clone calf, born in winter of 2002, was one of the favorites when she was at Cyagra. Using the merchandising options that cloning creates, Alicia's owners sold Alicia's Clone before it was born for $100,000 in October of 2002.

Shoremar S Alicia 3E-97
6-10 2x 365d 35,760 4.3 1541 3.2 1147
All-American Age Cow 2003
All-American & All-Canadian 5-Year Old 2000
All-American People's Choice Winner 2000
Holstien International Cow of the Year 2000
All-Canadian 4-Year Old 1999
All-Canadian Jr. 2 Year Old 1997
Nominated for QII – Queen of the Breed 2004

January 2007: The European Food Standards Agency is seeking urgent legal advice after farmers announced the <u>birth of a calf whose genetic mother is the clone</u> of an American prizewinning dairy cow.

Would there be general acceptance of transgenic technology if it could be applied to engineering resistance to influenza in poultry and therefore lessen the risk of an influenza epidemic, such as the one in 1918 that killed more than 20 million people?

Clark,J. & Whitelaw,B. 2003. A future for transgenic livestock. *Nat. Rev. Genet.* **4**, 825-833

Best, S. 2006. Department of Philosophy, The University of TX Genetic science, animal exploitation, and the challenge for democracy. *AI and Society*. 20:6-21

"Animals are being designed and bred as living drug and organ factories, as their bodies are disrupted, refashioned, and mutilated to benefit meat and dairy industries."

Best, S. 2006. Department of Philosophy, The University of TX Genetic science, animal exploitation, and the challenge for democracy. *AI and Society*. 20:6-21

"Animals are being designed and bred as living drug and organ factories, as their bodies are disrupted, refashioned, and mutilated to benefit meat and dairy industries."

"Scientists need to enter into dialogical relations with the public to discuss the complexities of cloning and stem cell research to make their positions clear and accessible, as well as accountable and responsible, while public intellectuals and activists need to become educated in biotechnology in order to debate biotechnology issues in the media or public."

"Biotechnology must be used within ethical constraints. It is the task of bioethics to help society develop those constraints"

- American consumers (75%) and scientists (70%) agree that cloning and genetic engineering of animals raise some moral and ethical issues
- However public is much less likely to approve (21-25%) of these technologies than scientists (60-68%)

Keystone Research Center (2004) – Biotechnology and ethics: a national survey of consumers and scientists. Report to the Biotechnology Industry Organization. KRC Research, Washington DC, 29pp.

"*Biotechnology must be used within ethical constraints. It is the task of bioethics to help society develop those constraints*"

- American consumers (75%) and scientists (70%) agree that cloning and genetic engineering of animals raise some moral and ethical issues
- However public is much less likely to approve (21-25%) of these technologies than scientists (60-68%)
- Animal scientists must become conversant and willing participants in the consideration of ethical issues and concerns surrounding the implementation of their work if they wish to be involved in reaching the societal consensus as to ***which ethical constraints*** will ultimately be applied in determining acceptable uses of animal biotechnology


B
Red
Orange
Yellow
Green
Wild Type


GMO'S
TREATOR
TRICK?


HUMAN GROWTH HORMONE GENE
MT
PROMOTER
pBR