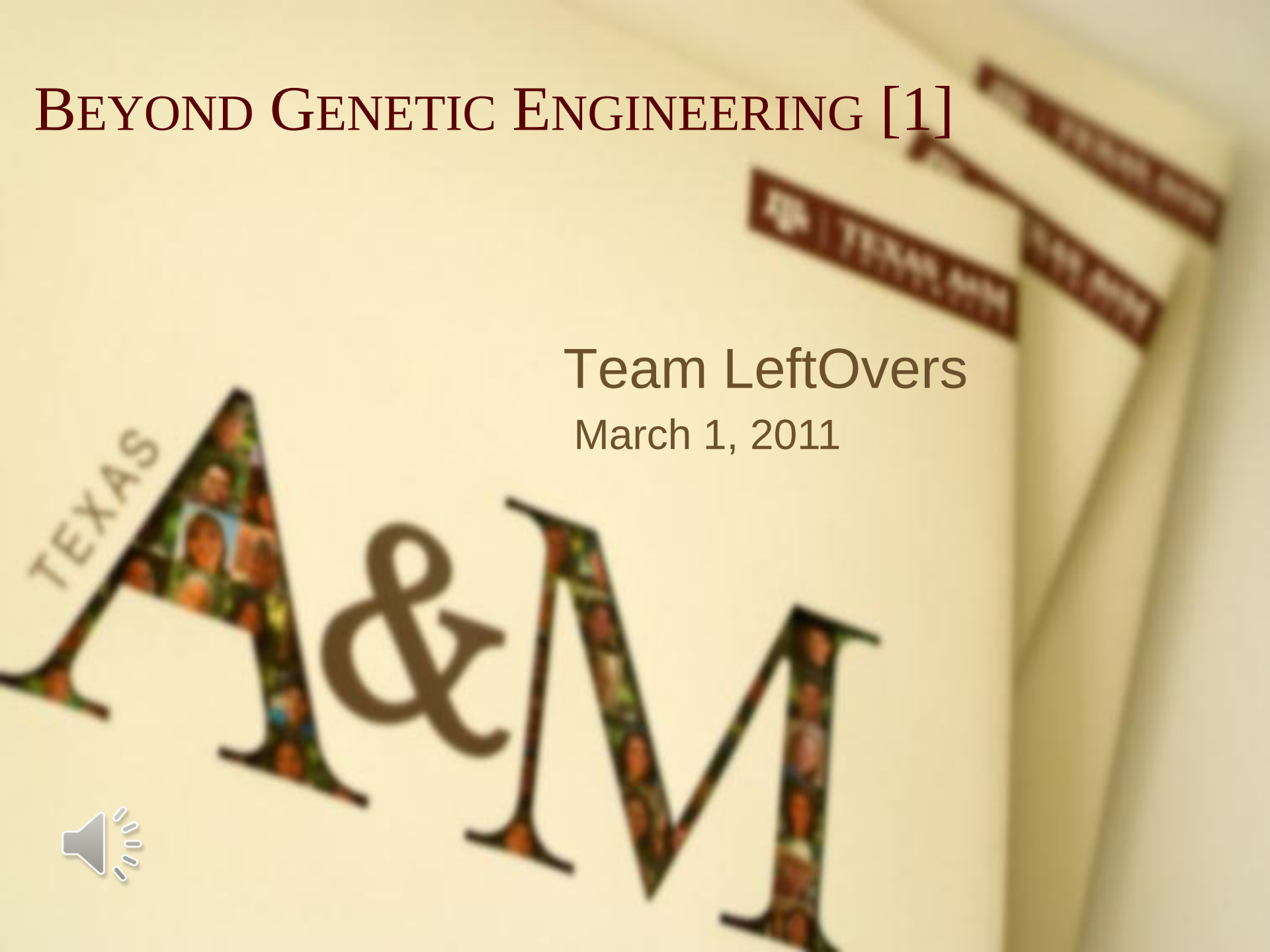
Beyond Genetic Engineering [1]

Team LeftOvers

March 1, 2011



JUSTIFICATION [2]

- **Synthetic fuel**
- **Gene therapy**
- **Curing disease**
- **Creating tougher foods**

Outline

- History of genetic engineering
- Past projects
- Craig Venter and synthetic life
- Ethical considerations
- Road Ahead
- Conclusions

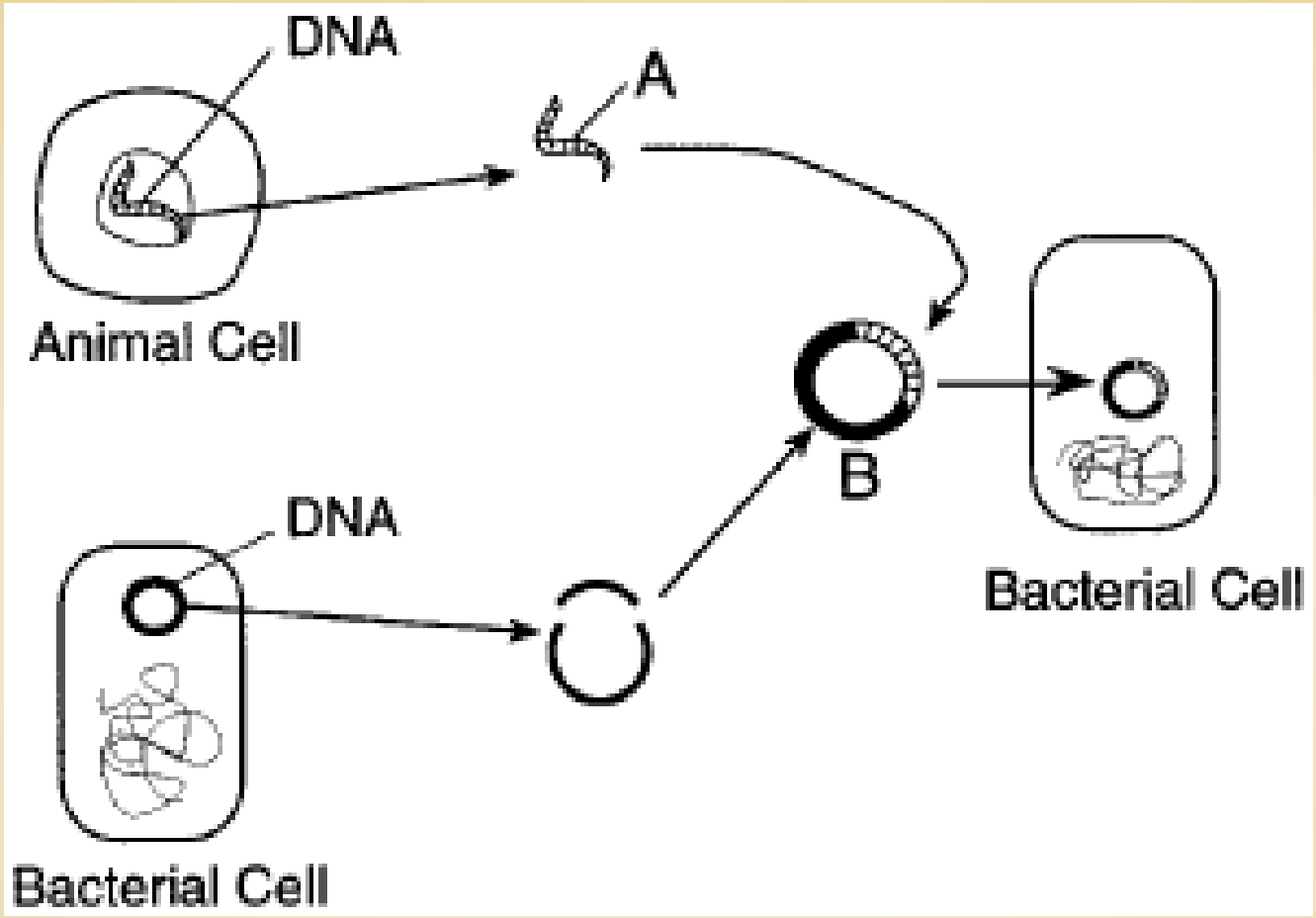
History Of Genetic Engineering [3,4]

- 1944:

  DNA identified as the carrier of genetic information (Mcleod and McCarty)
- 1953:

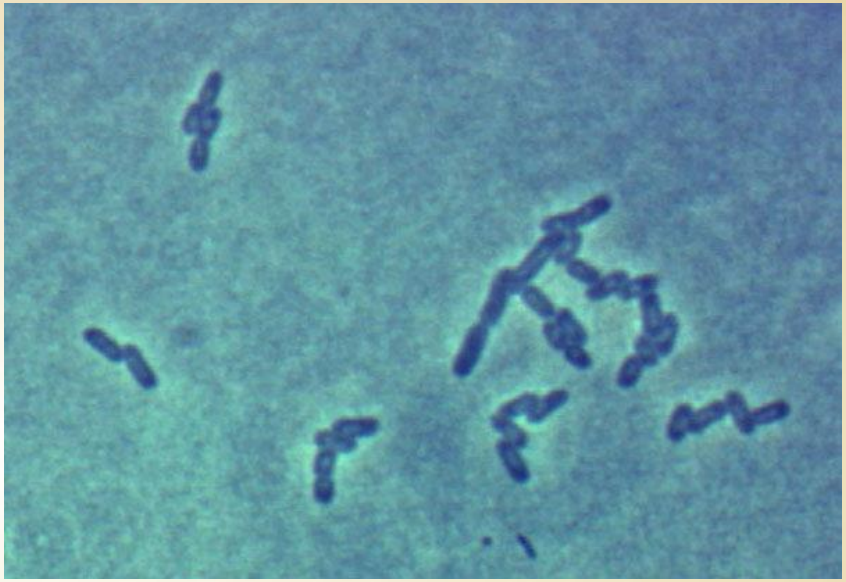
  Structure of DNA Discovered (Watson and Crick)

RECOMBINANT DNA TECHNIQUES [5]



Initial Success [6]

- 1977: E.Coli bacteria made to produce insulin
- FDA approved and sold commercially
- 1st genetically engineered organism
- Traits found in nature could be imparted on other organisms



Human Genome Project [7,8]

- Hoped to map 20,000-25,000 human genes
- Completed in 2003
  - Working model of human genome announced
  - Mapped 92%

Interesting Projects [9,10]

Dolly the Sheep

Born on July 5, 1996 at Scotland's Roslin Institute

First mammal cloned from an adult cell

Euthanized in 2003 because of lung cancer

Maroon Carrots

- "BetaSweet" carrots
- Developed 10 years ago by Professor Emeritus Leonard M. Pike for fun
- Coloring comes from the antioxidant anthocyanin.
- Based off wild carrots collected in Brazil

Interesting Projects [11,12]

The Glowing Bunny

Named Alba

Created in 2000 by Eduardo Kac

Embryo injected with a green phosphorescent protein found in jellyfish

Photosensitive Flies

Gero Miesenboeck & his team at Yale

Engineering fruit flies to be light-sensitive in the neural area responsible for escape

Beheaded flies so they could not move, unless the modified cells were flashed with light

SYNTHETIC LIFE [13]

- **“We’re here today to announce the first synthetic cell.”**
- **“This is the first self-replicating species that we’ve had on the planet whose parent is a computer. It also is the first species to have its own website encoded in its genetic code.”**

Synthetic Life

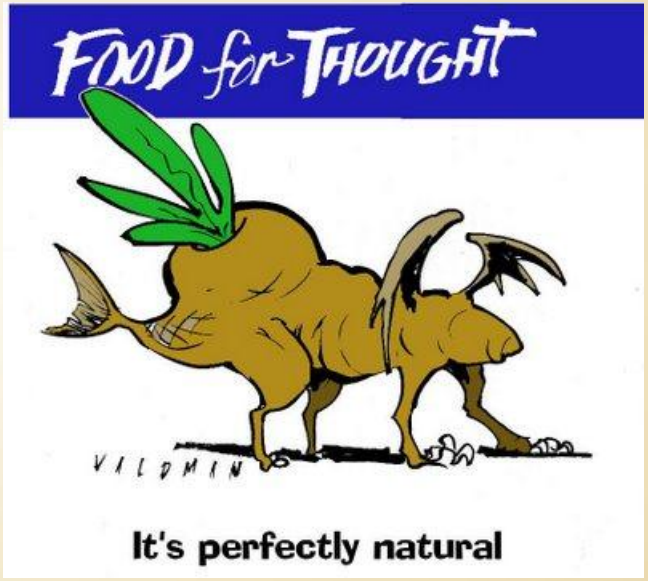
- **Simplest life goal**
  - Synthesis necessary
- **Two sides of synthesis**
  - Biology – incorporation
  - Chemistry – accuracy, watermarking

Synthetic Genomics [14]

- **When asked how significant synthetic life is:**
  - "Perhaps it is a giant philosophical change in how we view life. We actually view it as a baby step in terms of it has taken us fifteen years to do an experiment that we wanted to do fifteen years ago."
- **Privately owned spin-off company**
- **Employs more than 400 scientists**
- **In July 2009, ExxonMobil invested $600 million in Synthetic Genomics**
  - New life form to create oil from CO_2, water and light

Ethical Considerations [15]

- **Environmental**
  - New species affecting natural environment
  - Human health concerns
- **Religious/Moral**
  - Should we play God?
  - Does this go against nature?
- **National Security**
  - Terrorism
  - Biological Warfare



Road Ahead [16,17]

- **Projections for the near future**
  - 2011-2014 - Customized cells
  - 2011-2016 - 20%+ efficient genetically engineered algae ponds to generate hydrogen
  - 2015-2025 - Almost all fish (for food) comes from massive isolated land-based fish farms, some with volumes approaching a cubic mile.
  - 2011-2020 - Future Crime: Genetic modification of baby DNA to pass false paternity lawsuit
  - ?- Customizable offspring
- **Regulations on allowable genetic alterations**

Conclusions

- **Humans are experimenting with their surroundings in ways never seen before**
- **New synthetic biology has the potential to provide many new tools for mankind**
- **Synthetic biology also creates many ethical dilemmas that will be faced in years to come**

"What I cannot build I cannot understand."

– Richard Feynman

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QUESTIONS?