High School Science Fair Projects

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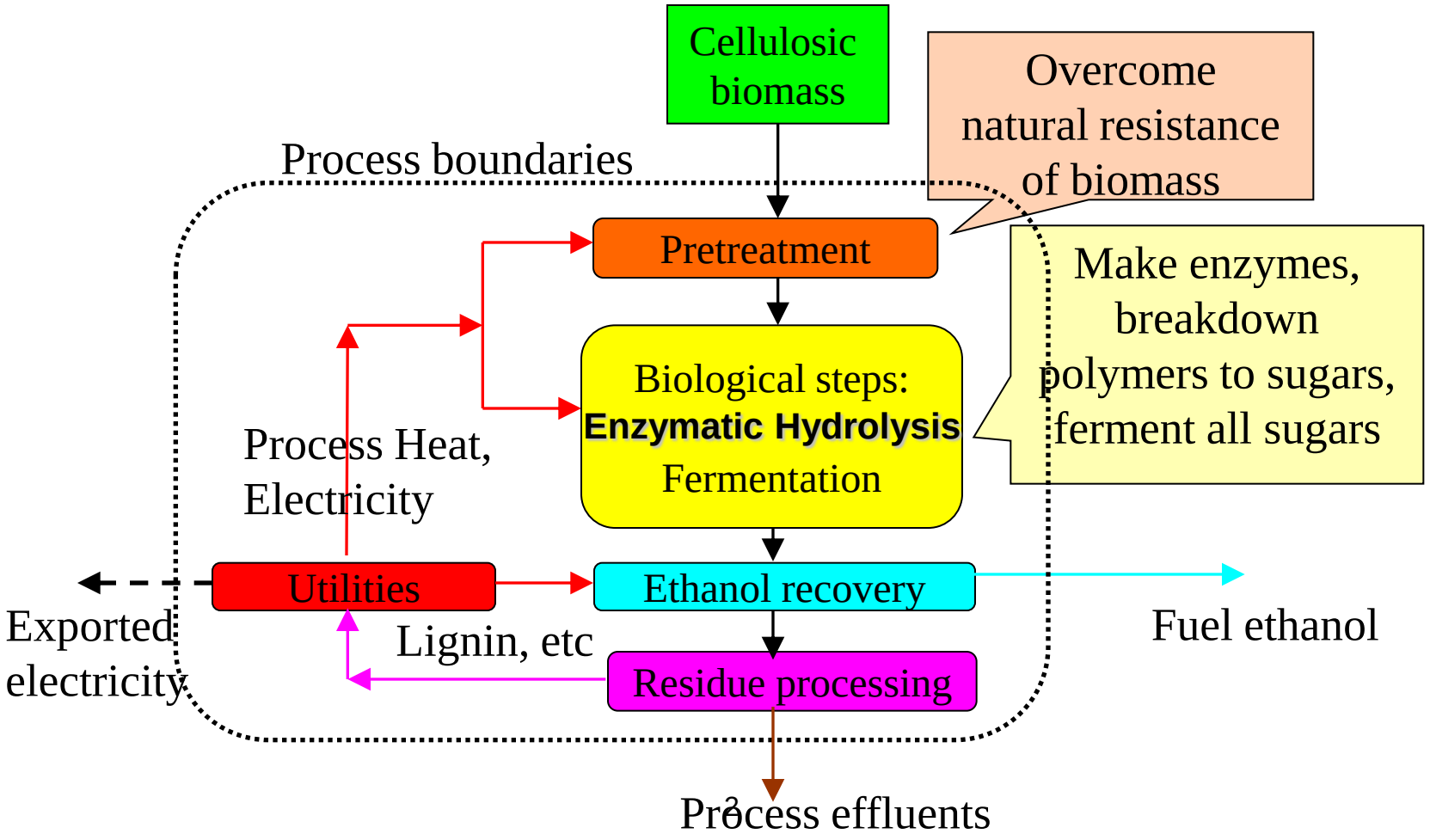
Cellulosic Ethanol Team

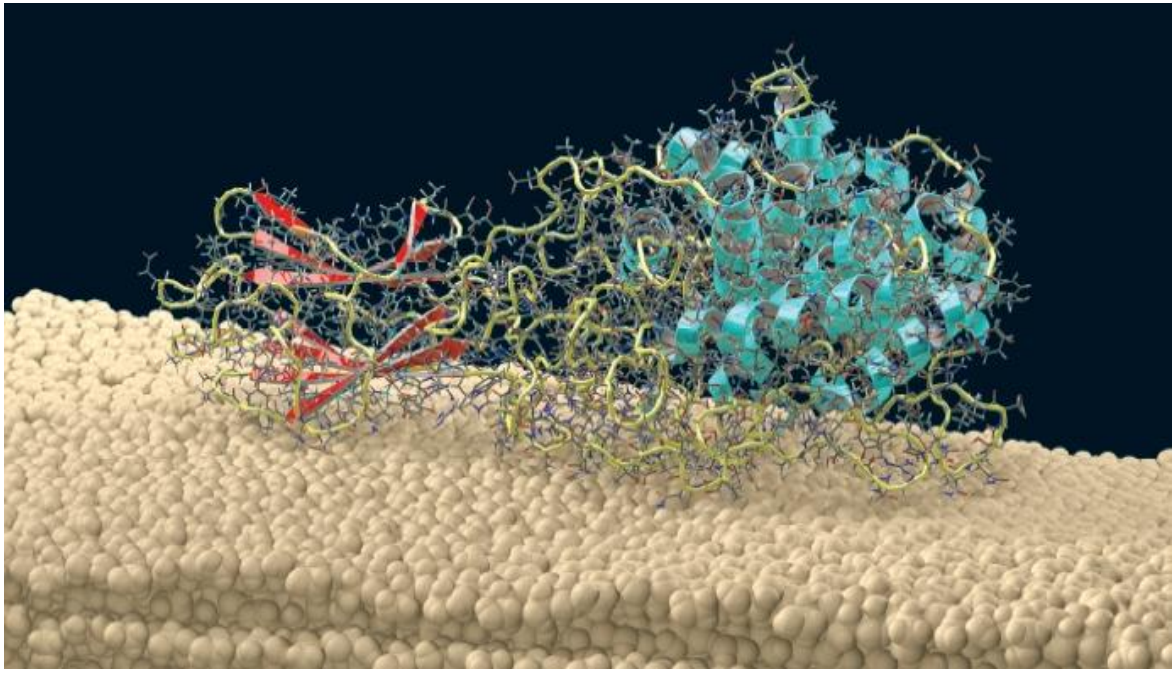
Lead by Dr. Charles Wyman

Biofuel Production
Cellulosic Biomass to Ethanol



Enzymatic Hydrolysis

- Enzymes work to break down the cellulose into sugars
- Enzymes are expensive
- Lignin and other impurities can slow down enzymes



Cellulose-rich municipal solid waste fractions

Mixed paper

Cardboard

ADC final

Woody waste

Grass waste

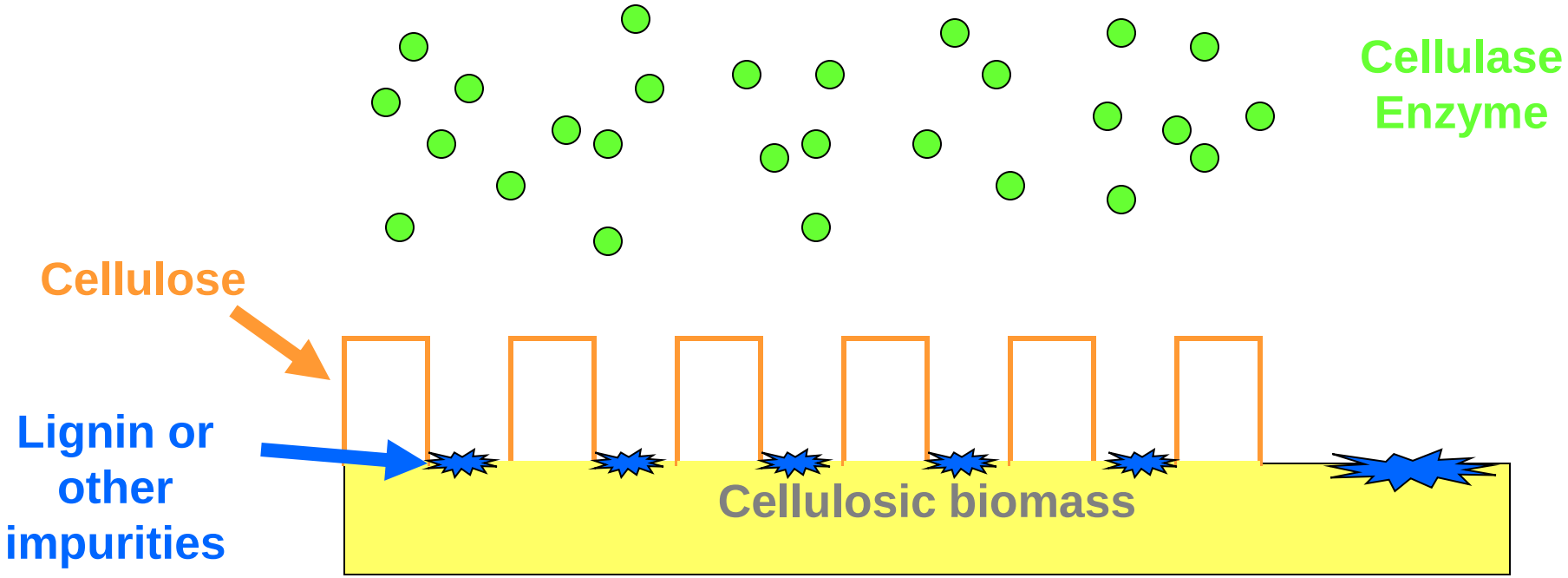
ADC green

Project 1

- Screening cheap protein sources to reduce enzyme cost during biofuel production

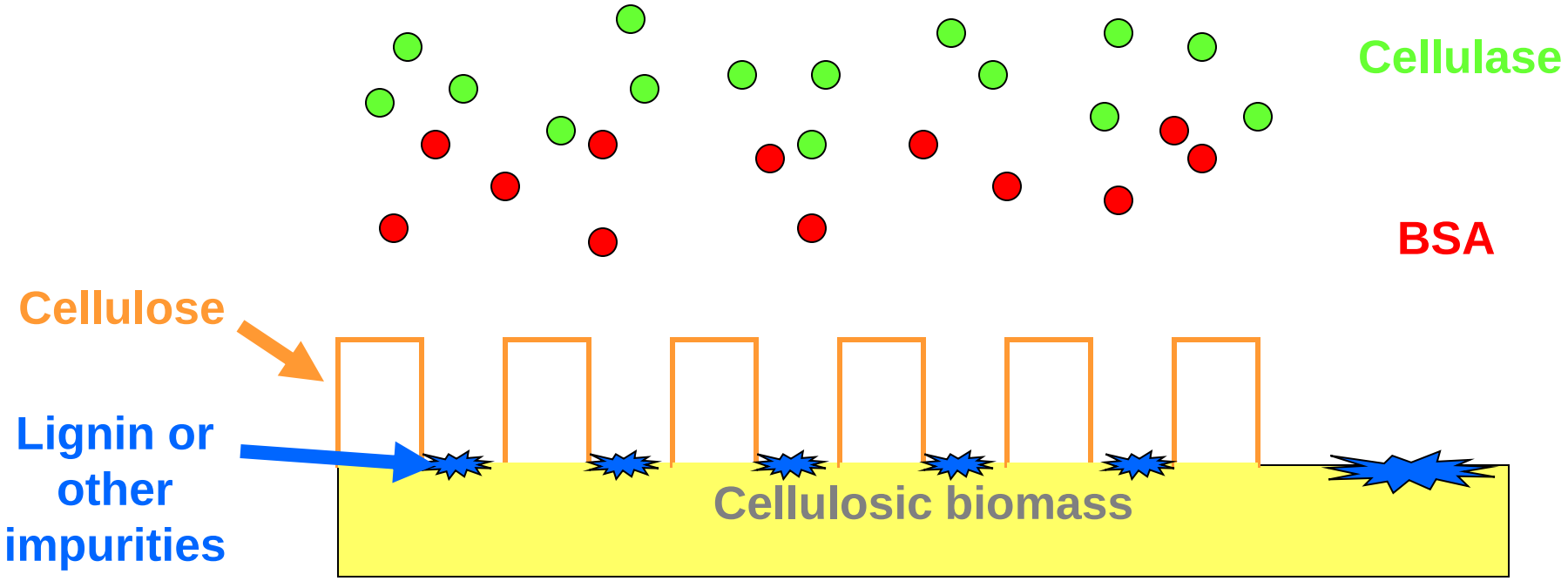
Problem Description

- Expensive cellulase enzyme attaches to lignin → reduced performance on cellulose hydrolysis



Proposed Solution

- Apply cheap protein to protect cellulase enzyme from attaching to lignin or other impurities

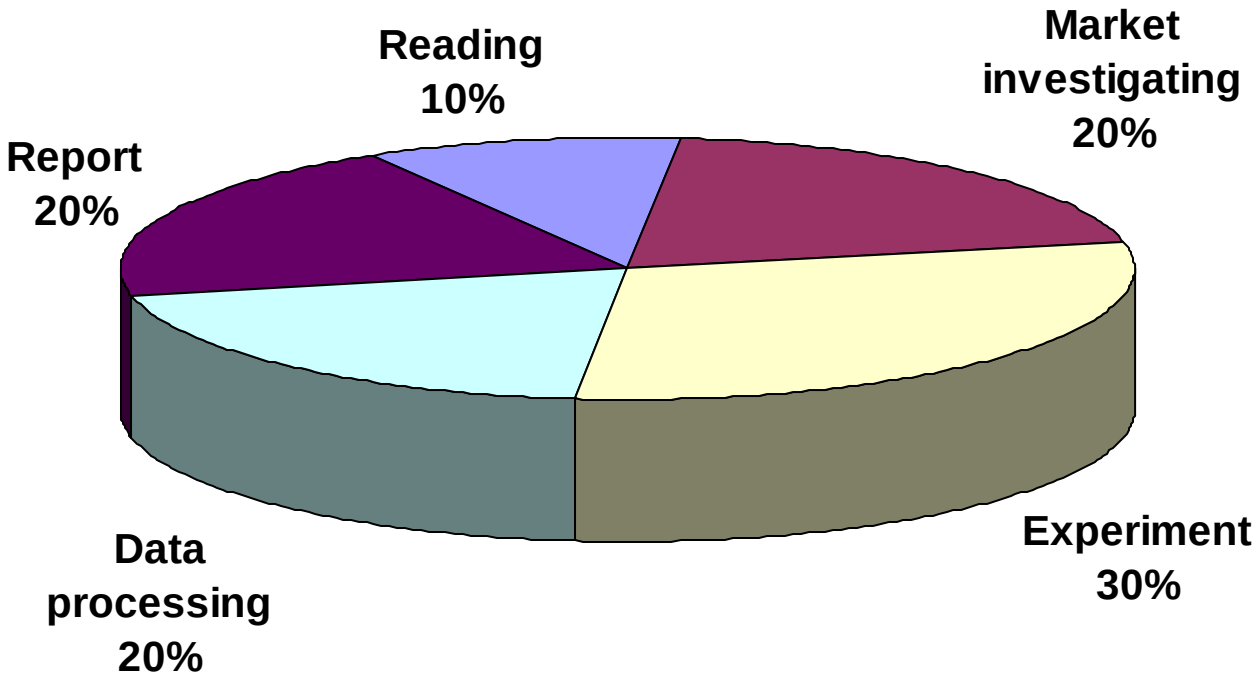


Goals

- Screen potential cheap protein sources
- Test binding capacity of cheap proteins on to lignin and cellulose
- Test how adding cheap protein helps to improve cellulose hydrolysis performance
- Demostrate how cellulase enzyme cost can be reduced

Expected Outcomes

- Analyze experiment data and prepare a written report summarizing findings

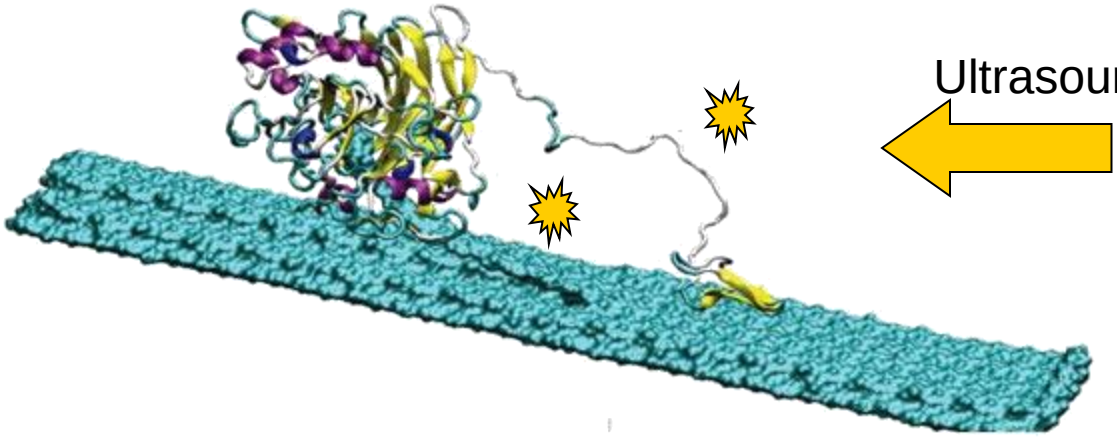


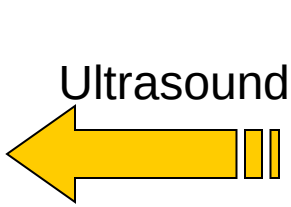
Project 2

- Use of ultrasound cleaner to improve sugar yield from enzymatic hydrolysis of cellulose

Assumption & Principle

- Cellulase enzymes rest on celllulose surface during hydrolysis
- Ultrasound clean surface
  - creates compression waves in liquids
  - microscopic ‘voids’ or ‘bubbles’





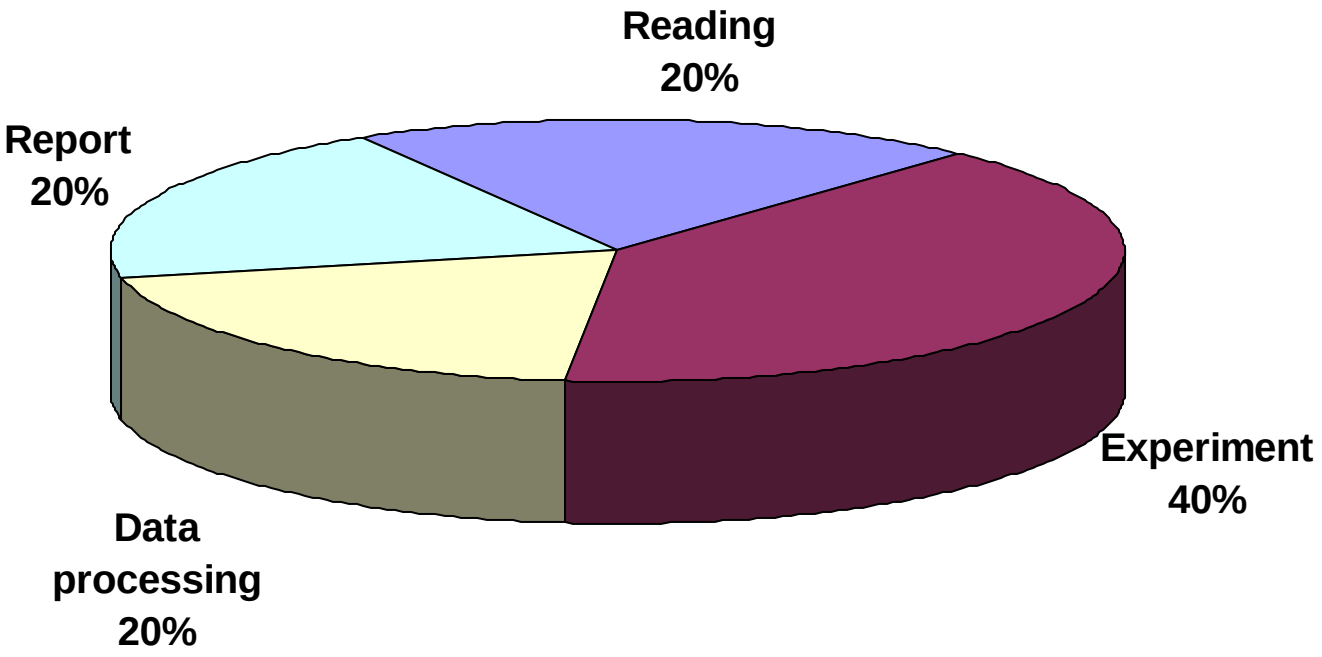
Sonicator

Goals

- Apply ultrasound to clean cellulose surface and activate cellulase enzymes
- Monitor enzyme activity before after ultrasound treatment
- Test ultrasound treatment time and frequency for best performance

Expected Outcomes

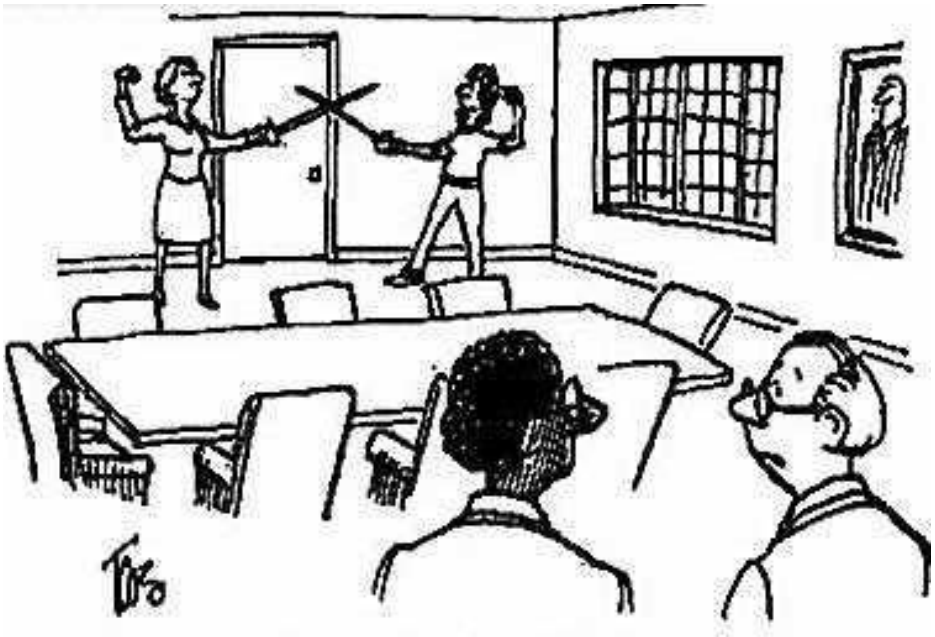
- Analyze experiment data and prepare a written report summarizing findings



Help me, I want to retire…

Project 3

- A survey on potential customers of bioethanol vs. biodiesel or solar/wind energy in California



Professors fighting

Goals

- How Big Is the Market, and Who Buys?
- Energy sectors that take biodiesel, bioethanol or other forms of alternative fuels in California
- Statistics to identify the winner (s)

Expected Outcomes

- A written report summarizing findings

Summary

- Project 1: Screening of cheap protein sources to reduce enzyme cost during biofuel production
- Project 2: Use of ultrasound to improve sugar yield from enzymatic hydrolysis of cellulose
- Project 3: A survey on the potential customers of bioethanol vs. biodiesel or solar/wind energy in California

Questions?