

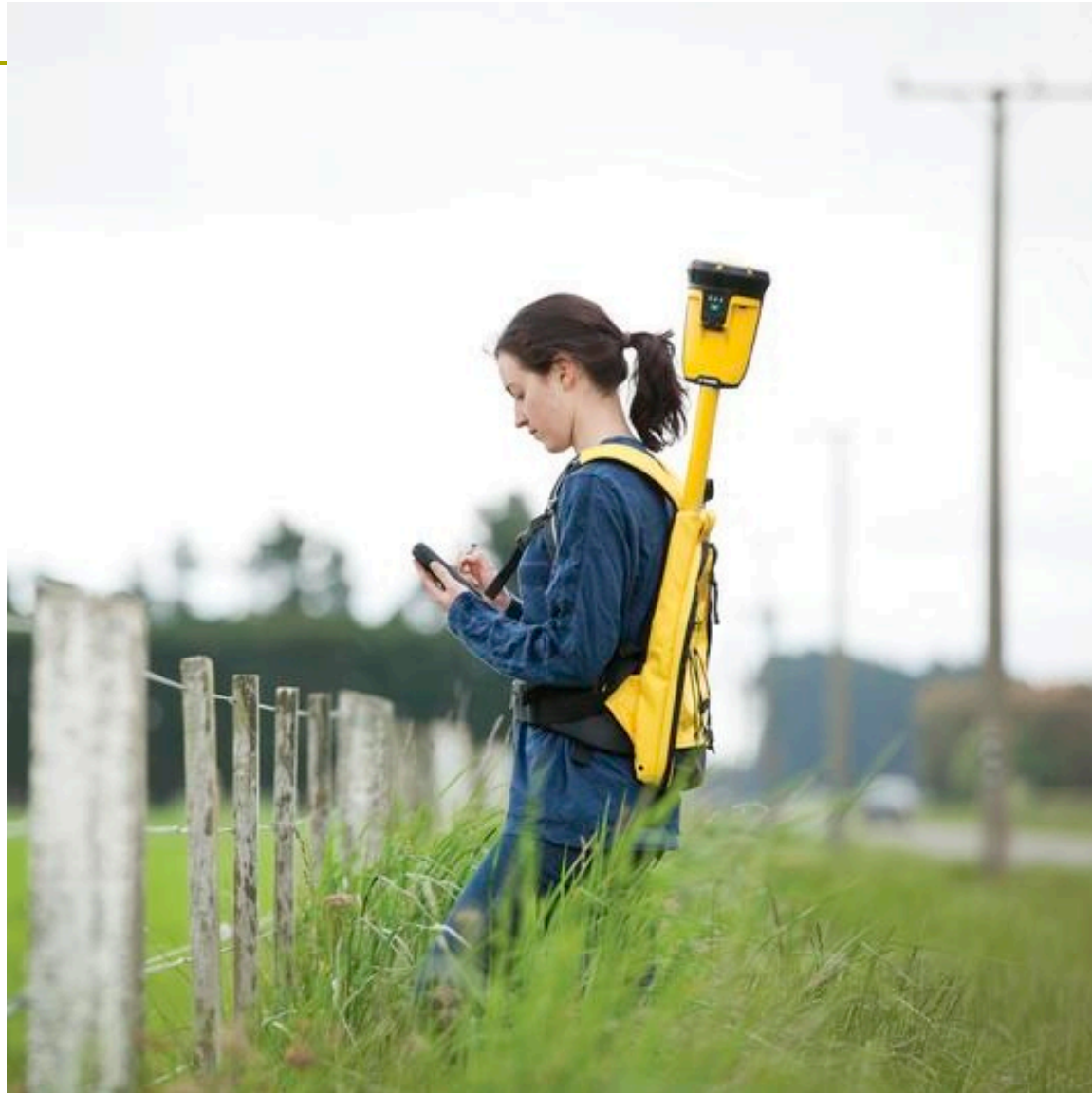
Using Bioenergy to Teach Energy Flows



This project is supported by an AFRI Cap Grant no. 2011-68005-30407 from the USDA National Institute of Food and Agriculture (NIFA).

Brian Hartman

Background



Precision Agriculture



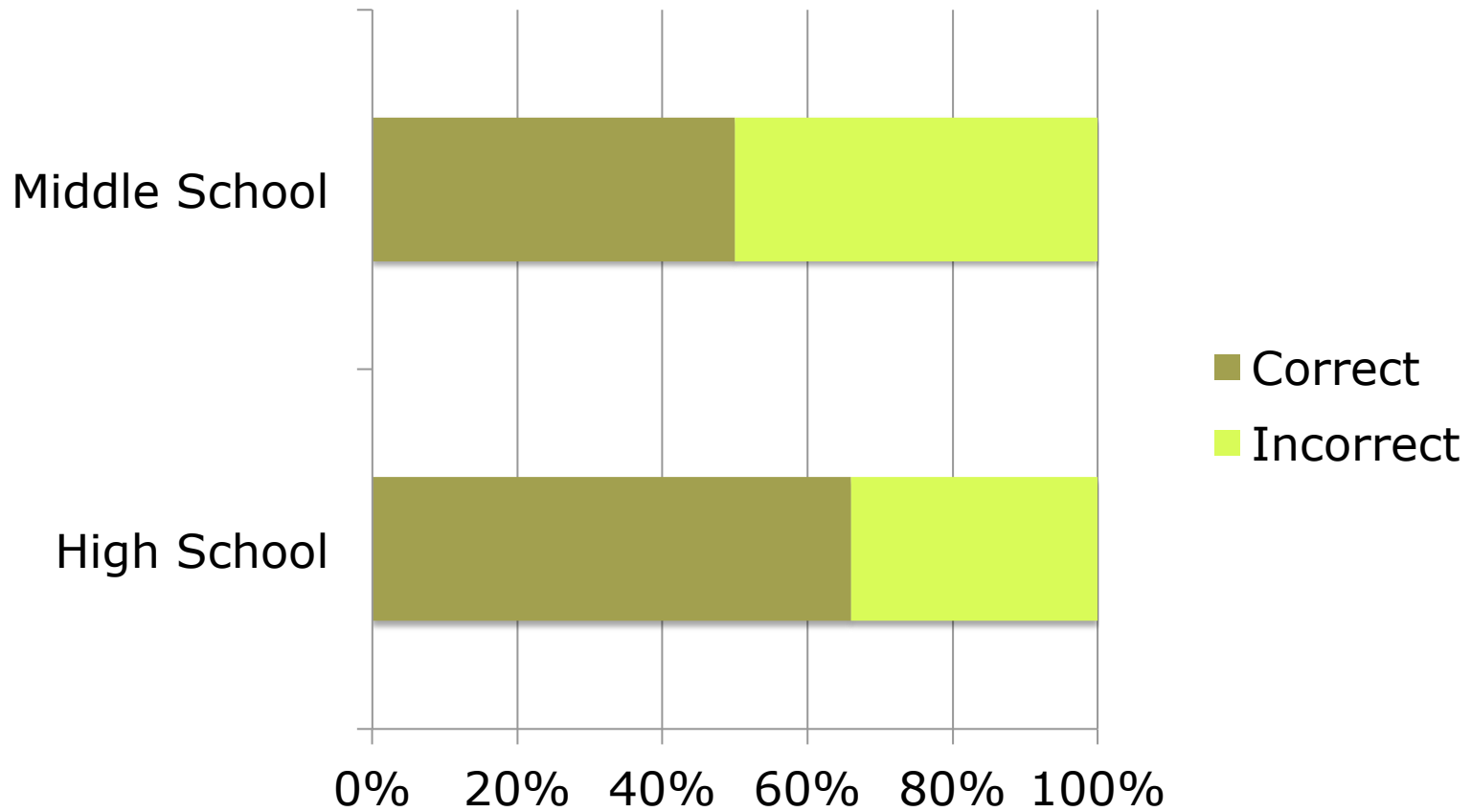
Procedure

- ❑ Add $\frac{1}{4}$ cup water to your bag (60ml)
- ❑ Add 1 teaspoon (one level plastic spoon of yeast to the bag.
- ❑ Add your station's material to the bag (~ 1 level spoon's worth).
- ❑ As you seal the bag, be sure to remove all air.
- ❑ Place bags on desk.

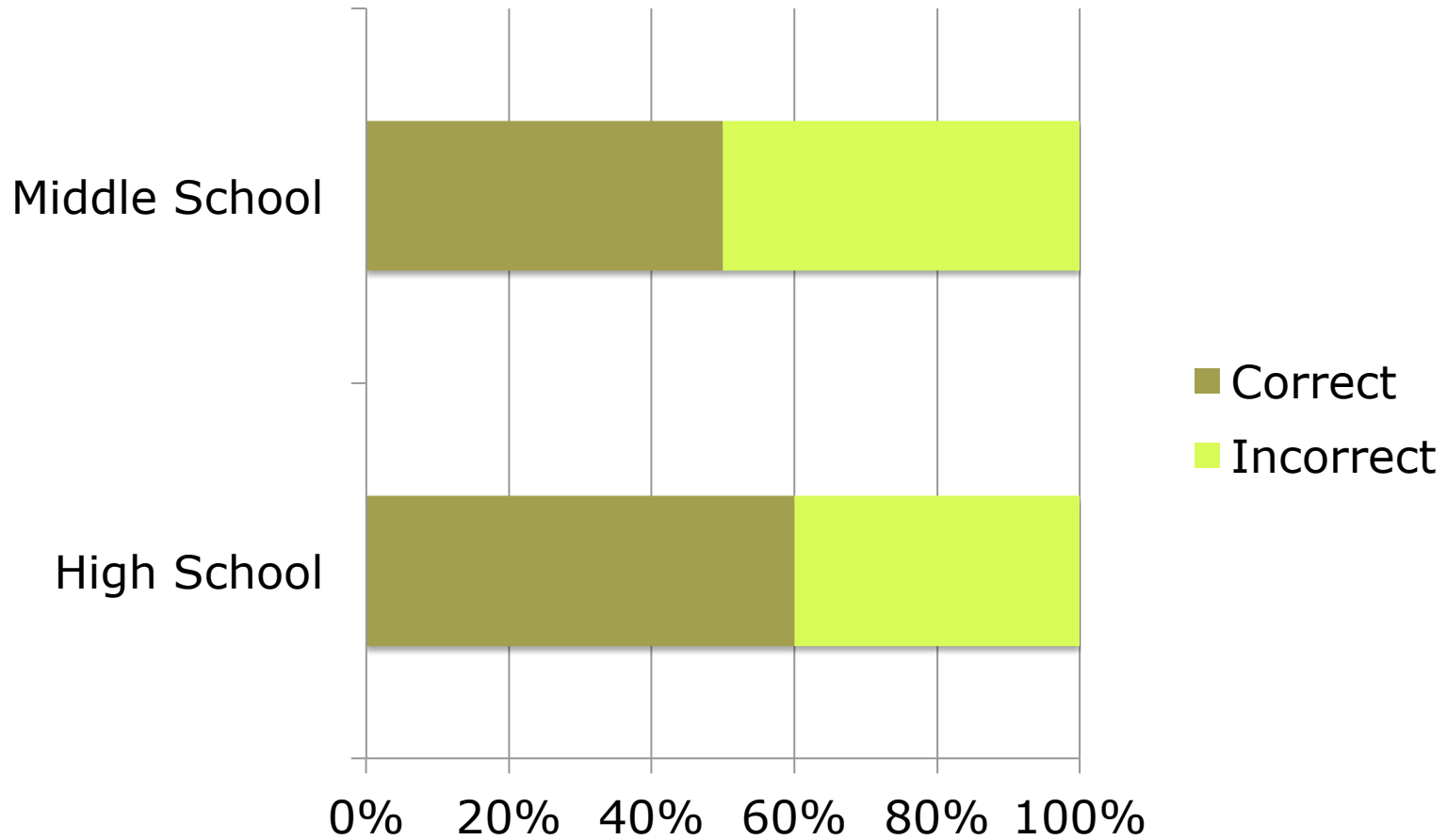
Energy IQ Quiz – Adults

- Which fossil fuel has the highest use in the US?
- How is most of the electricity generated in the US?
- In the past ten years, has the average MPG increased or decreased?
- 12% of adults passed (70% or higher)

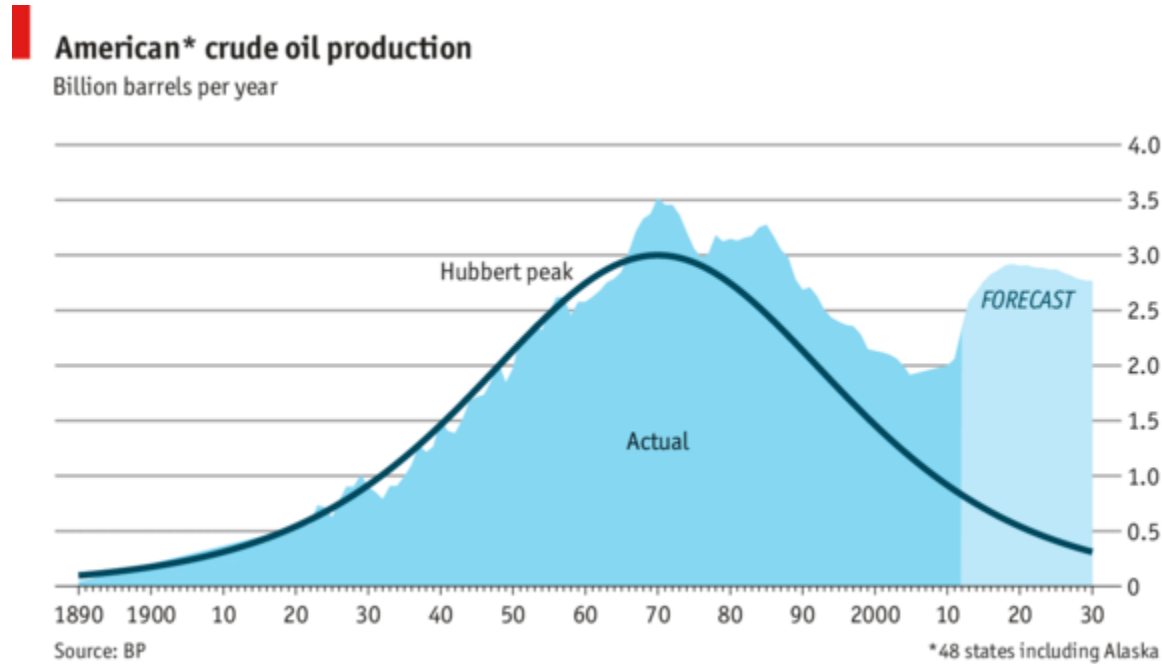
Do K-12 Students Know what ‘Renewable Energy’ Means?



Why can't we just switch to electric cars when we run out of fossil fuels?



The Peak

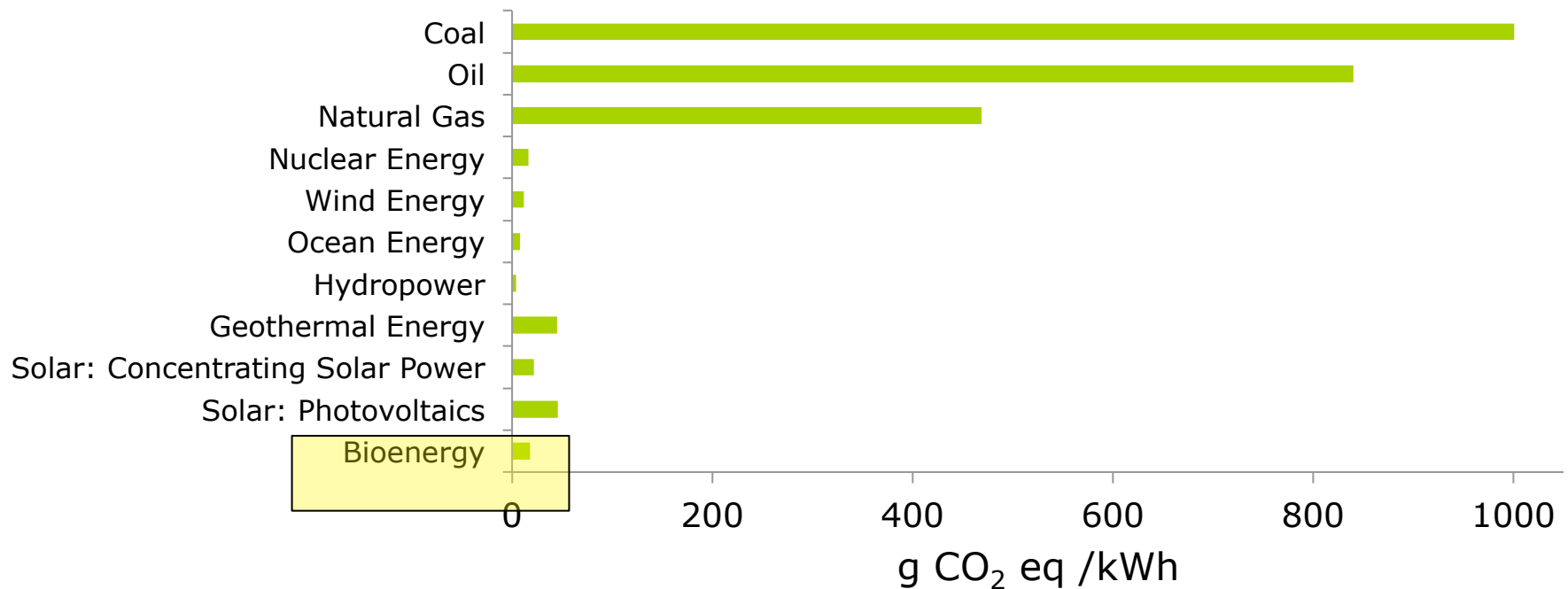


Economist.com/graphicdetail

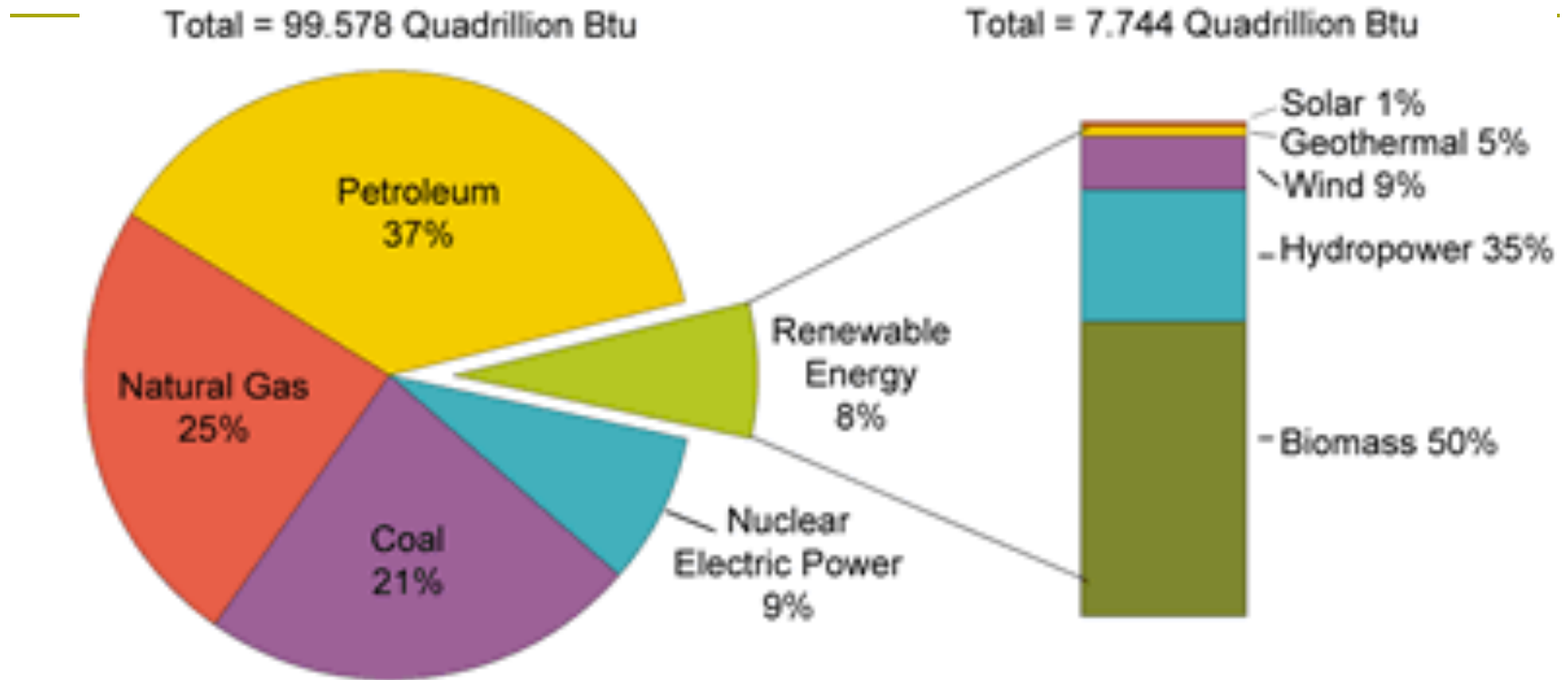


Why Renewable Energy?

- Sustainable supply of energy
- Reduce CO₂ emission
- Stronger rural economy

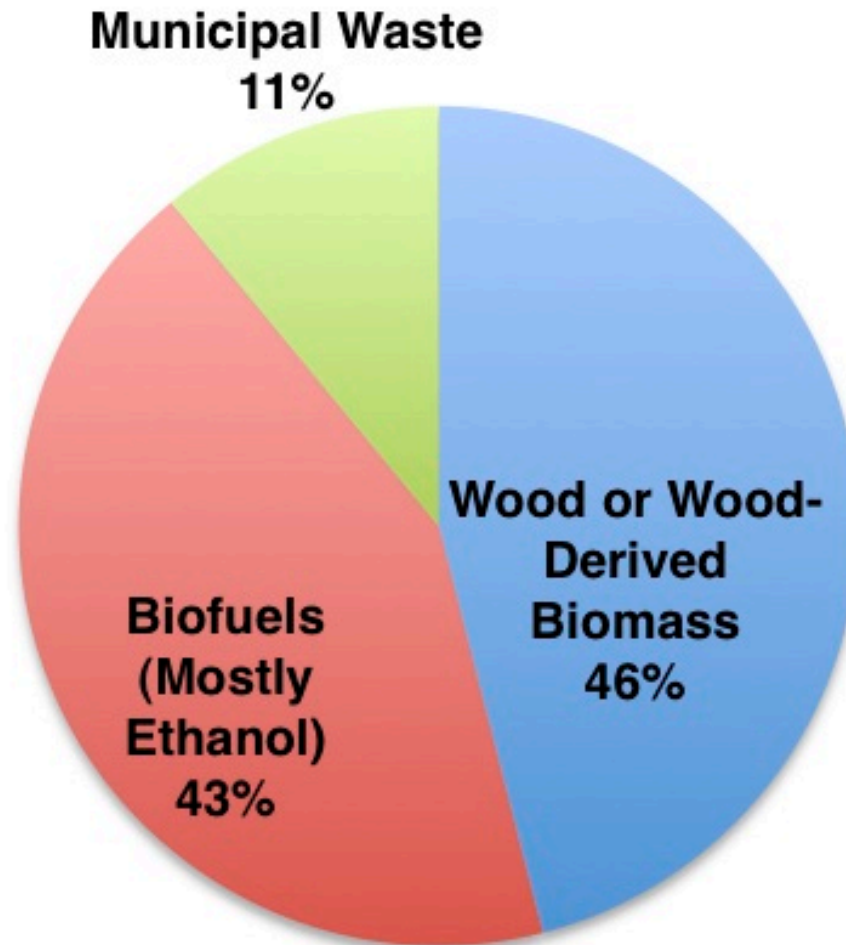


Where does the US get its energy?



Sources of Biomass energy?

— Sources of Biomass Energy 2010 —



Is bioenergy practical?



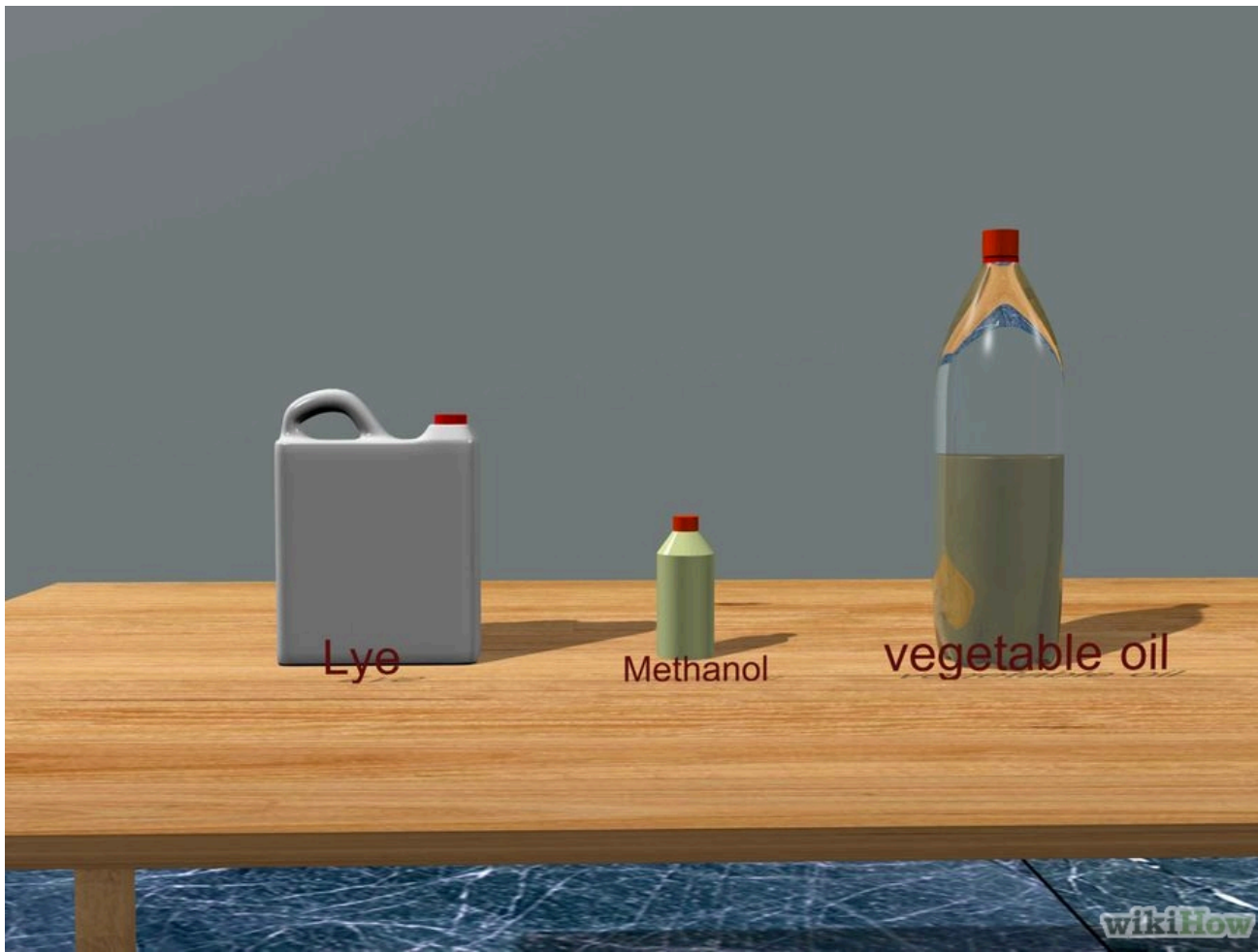


Mechanical Conversions



Chemical Conversions

WikiHow: Making Pop Bottle Diesel



What are Biological Conversions?



Which Materials Do Yeast Digest?

- ❑ Water
- ❑ Corn starch
- ❑ Sugar
- ❑ Sugar substitute
- ❑ Milk powder
- ❑ Milk w/ Lactaid
- ❑ Biomass -- paper

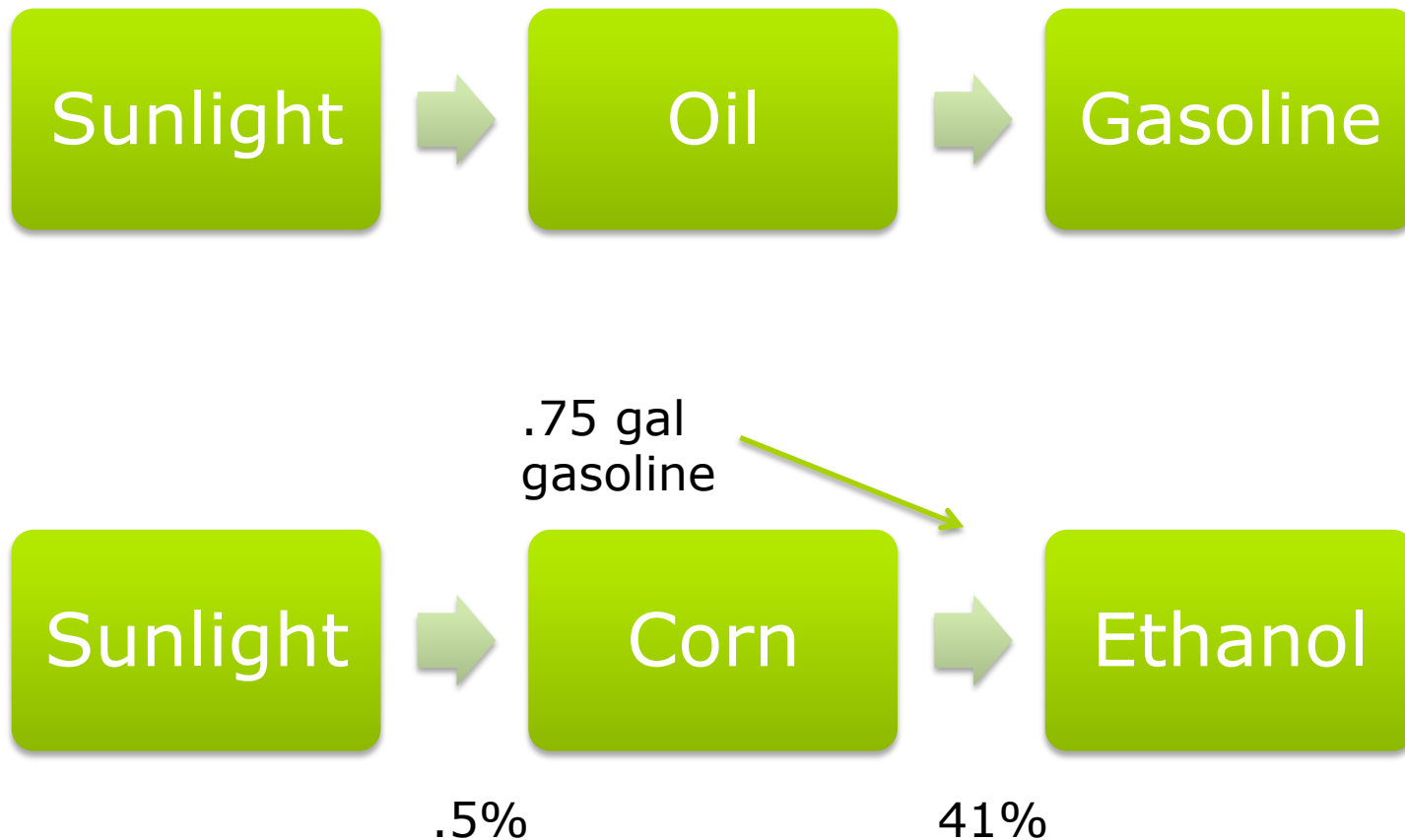
Linking the Yeast Experiment to Bioenergy

- Is yeast plant, animal, or fungi?

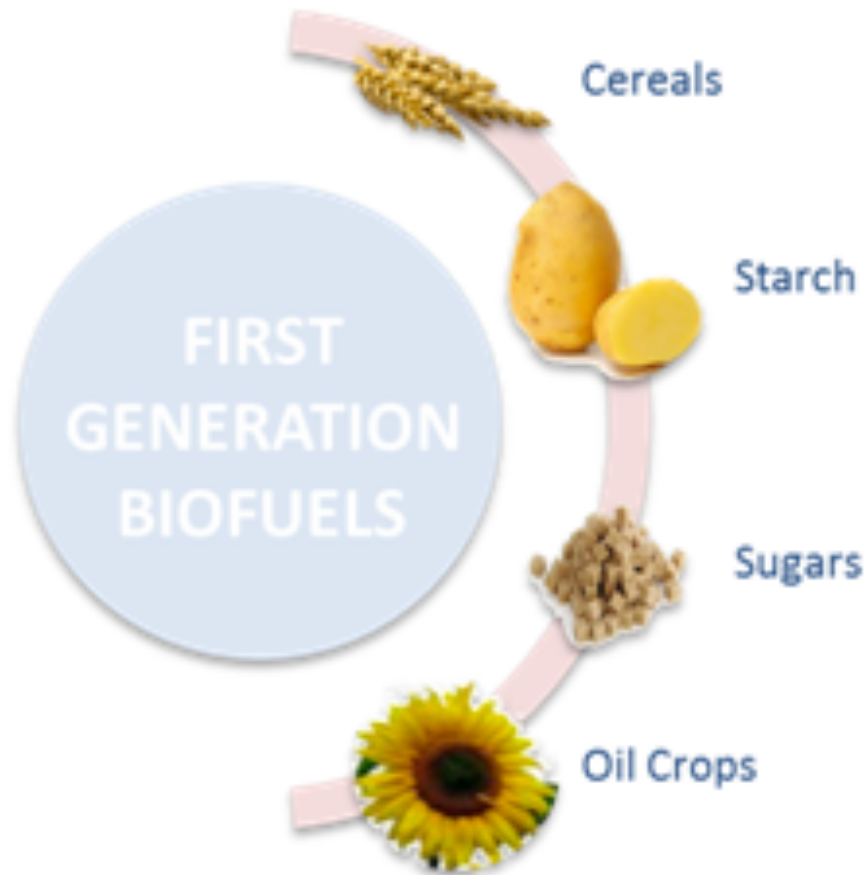
- Middle School?
 - Sugar + Yeast →
Alcohol + Carbon Dioxide

- High School?
 - $C_6H_{12}O_6 + \text{Zymase} \rightarrow$
 $2 C_2H_5OH + 2 CO_2$

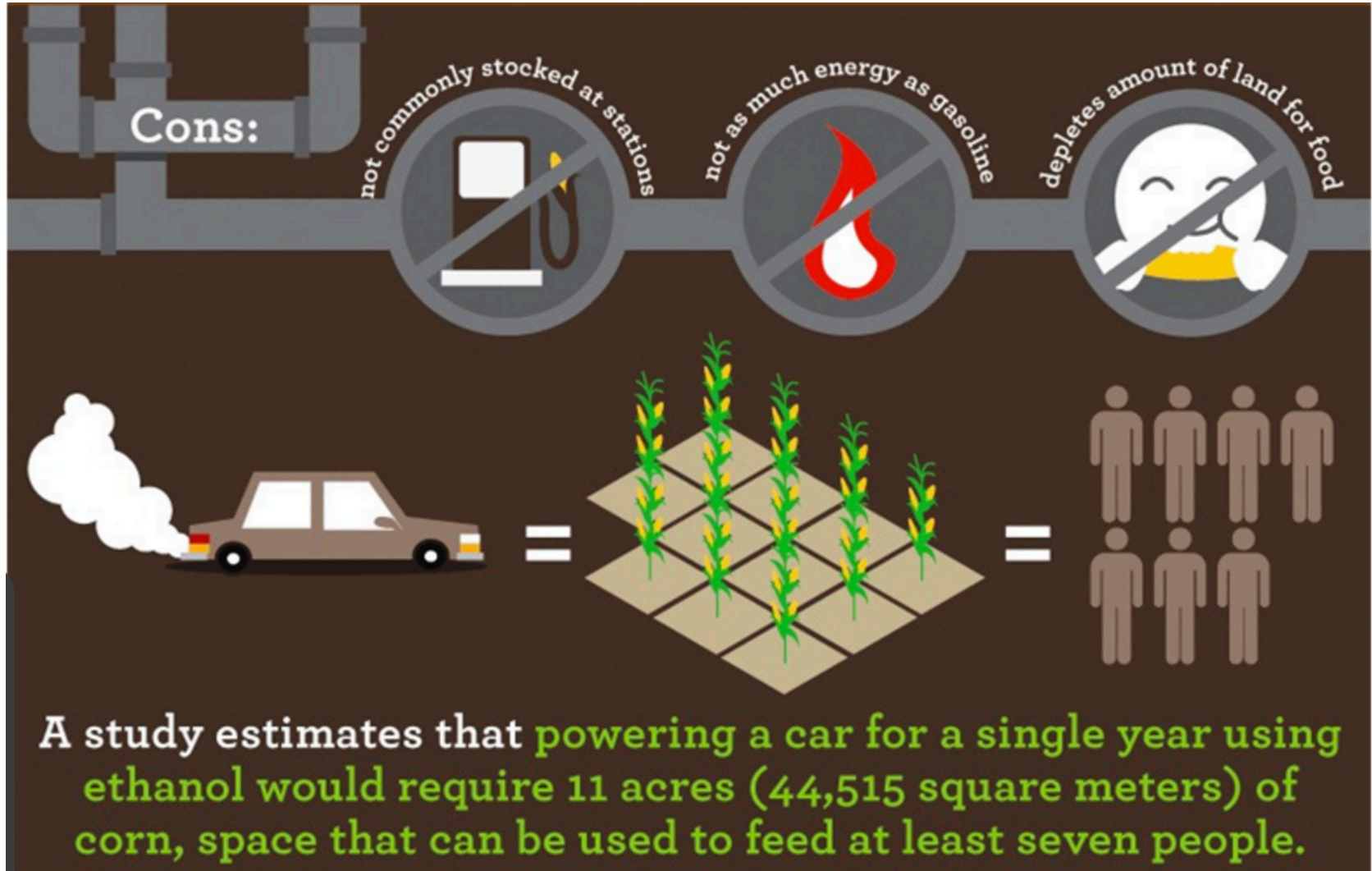
Energy Flows



First Generation Biofuels

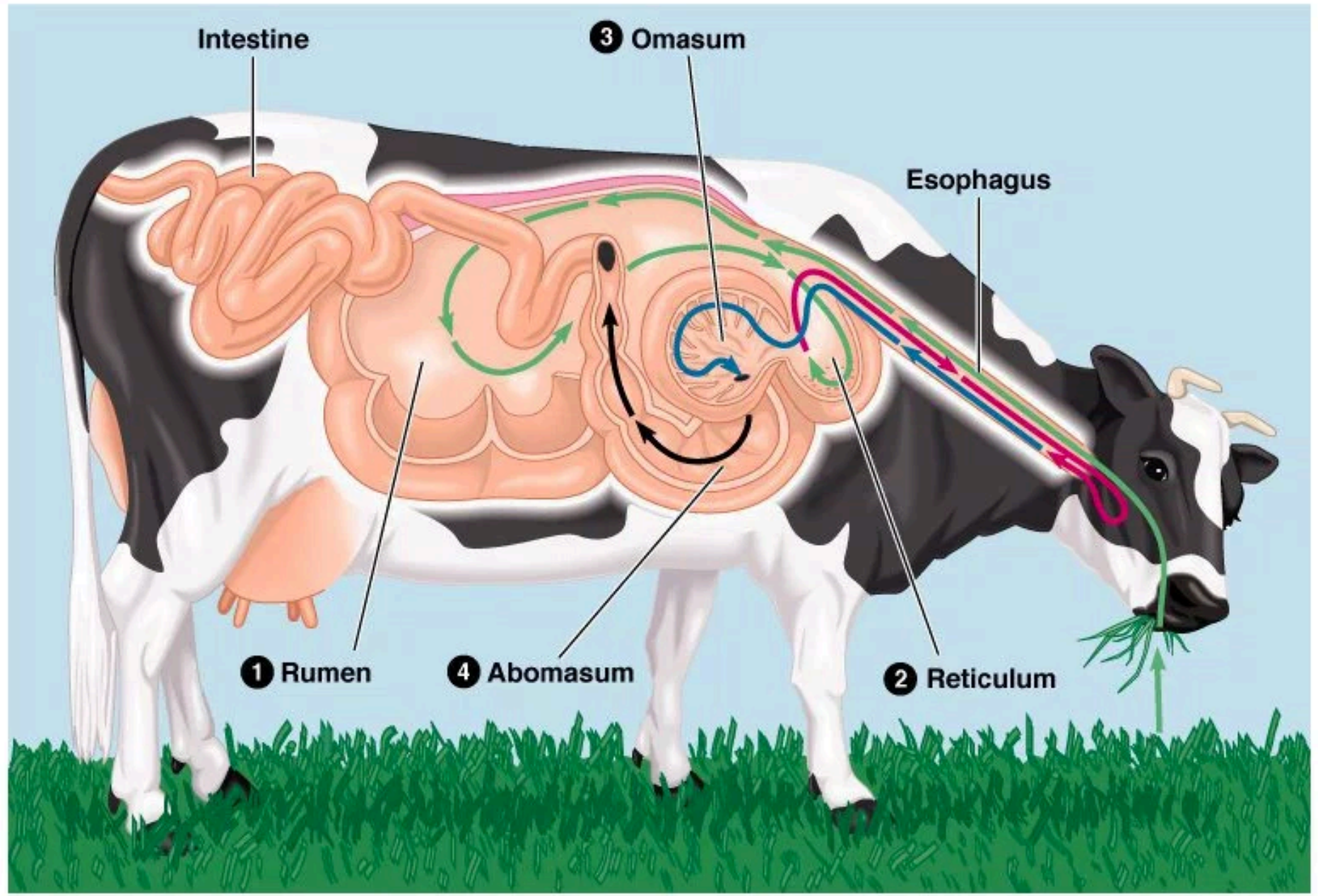


What Are Disadvantages of Ethanol?

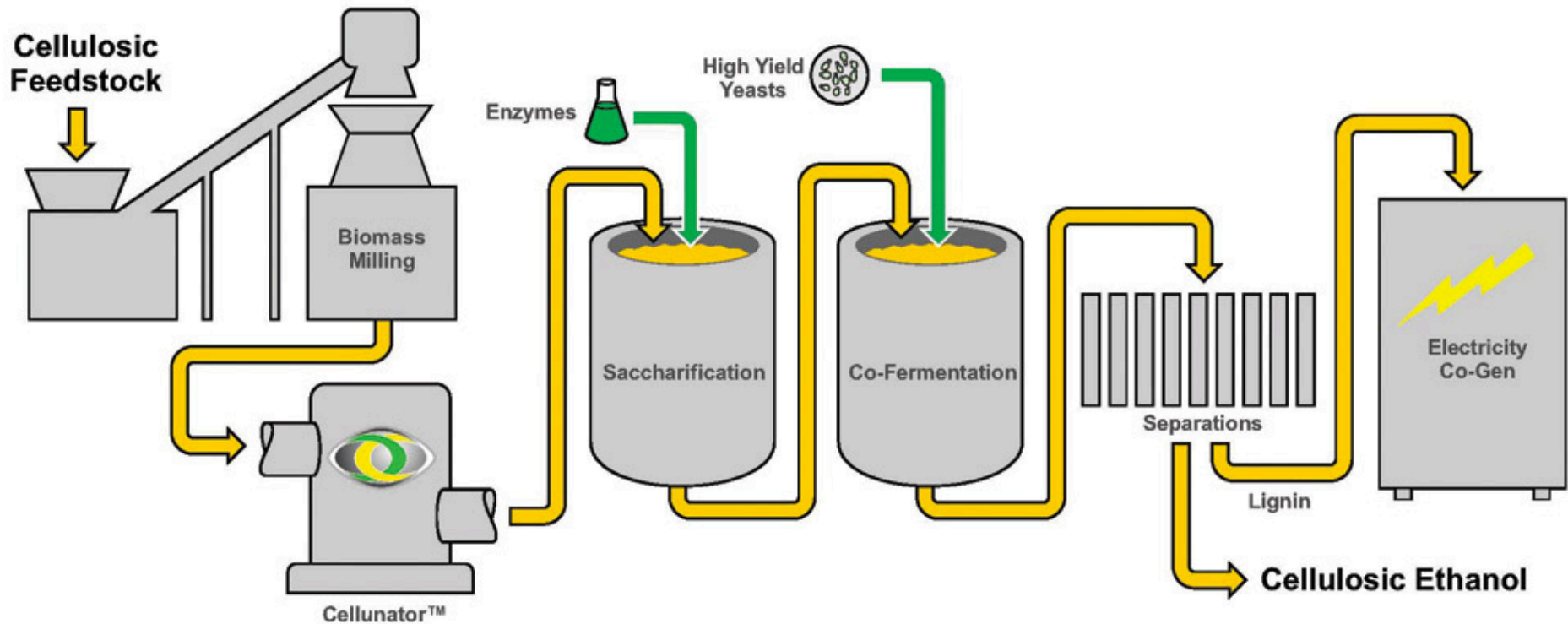


Second Generation Biofuels





Cellulosic Ethanol

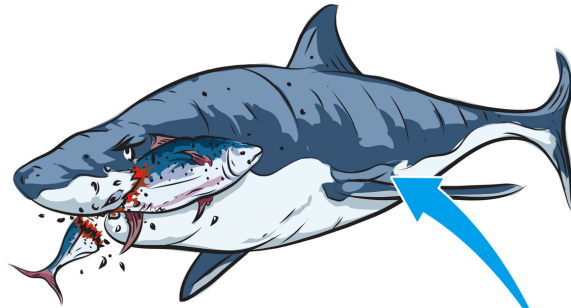


Third Generation Biofuels

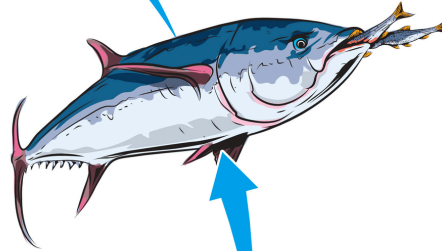


CLOSE X

**QUATERNARY
CONSUMERS**



**TERTIARY
CONSUMERS**



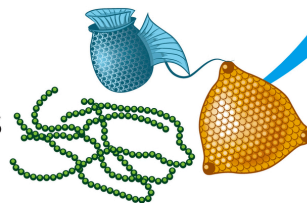
**SECONDARY
CONSUMERS**



**PRIMARY
CONSUMERS**



**PRIMARY
PRODUCERS**



Green Crude

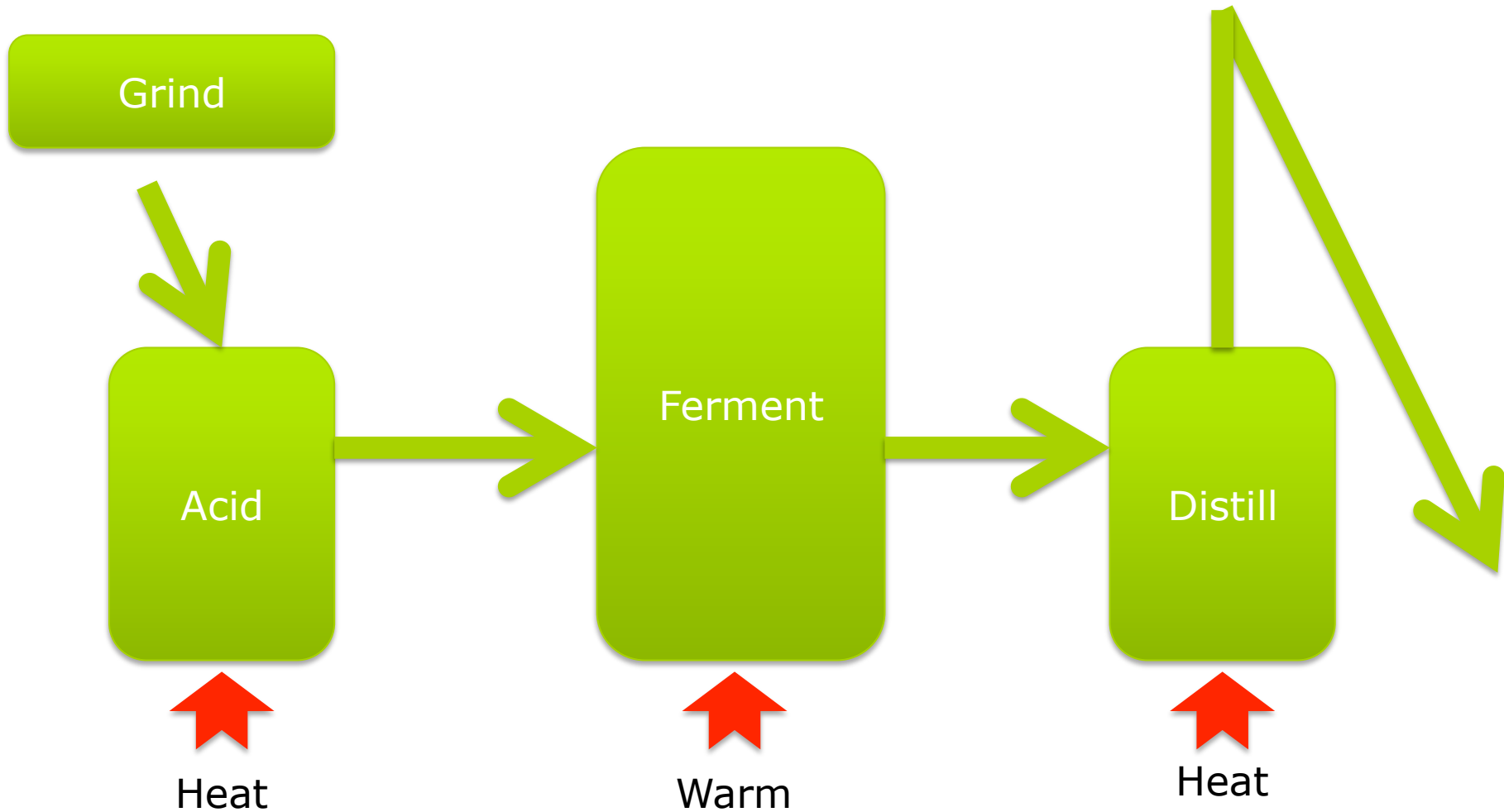


February 18, 2016

Design an Ethanol Plant



Design an Ethanol Plant



Implementation

- How could this activity be implemented in the curriculum?

