

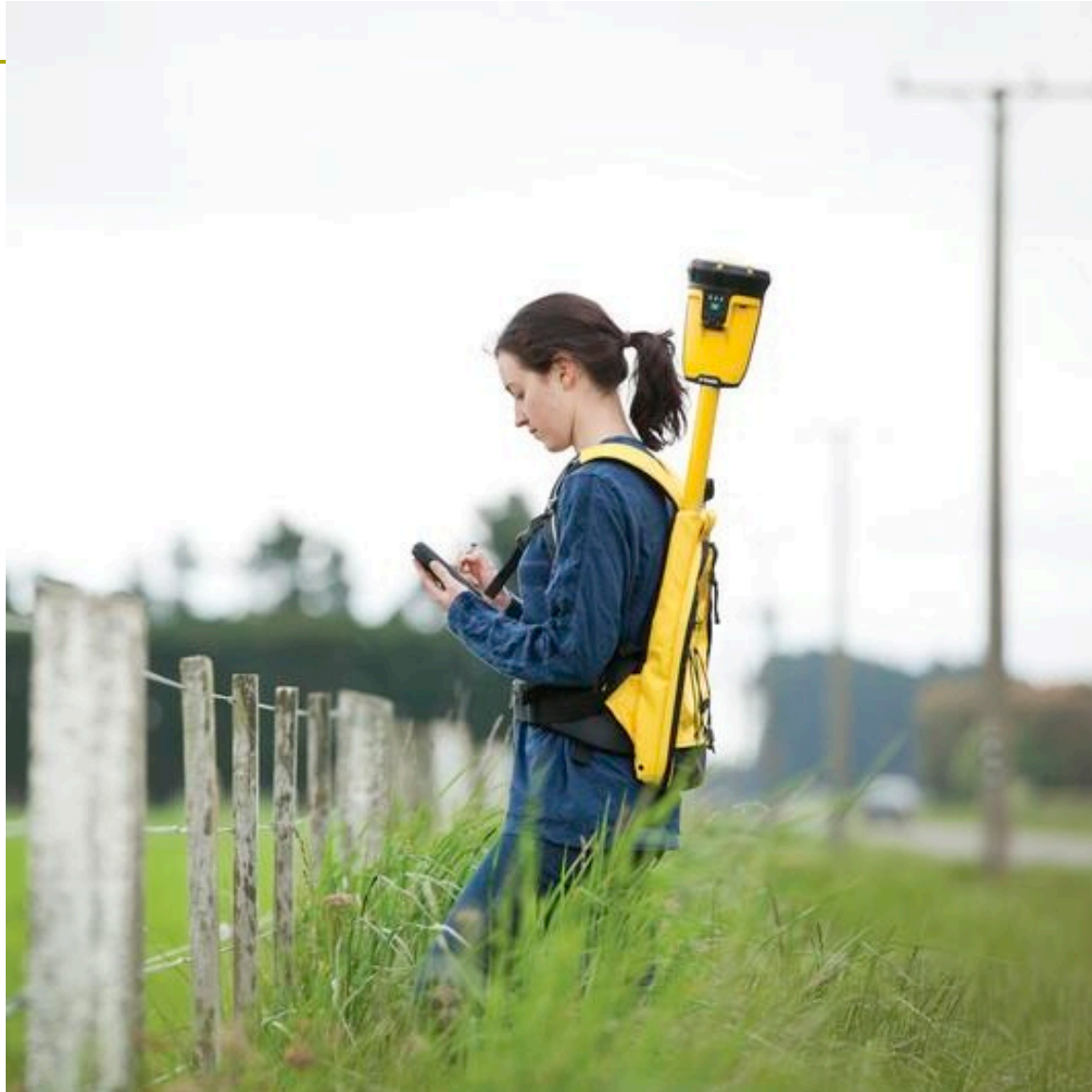
Cross-cutting Science and Engineering Standards Through Bioenergy



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OSU
Oregon State
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College of Education

Background



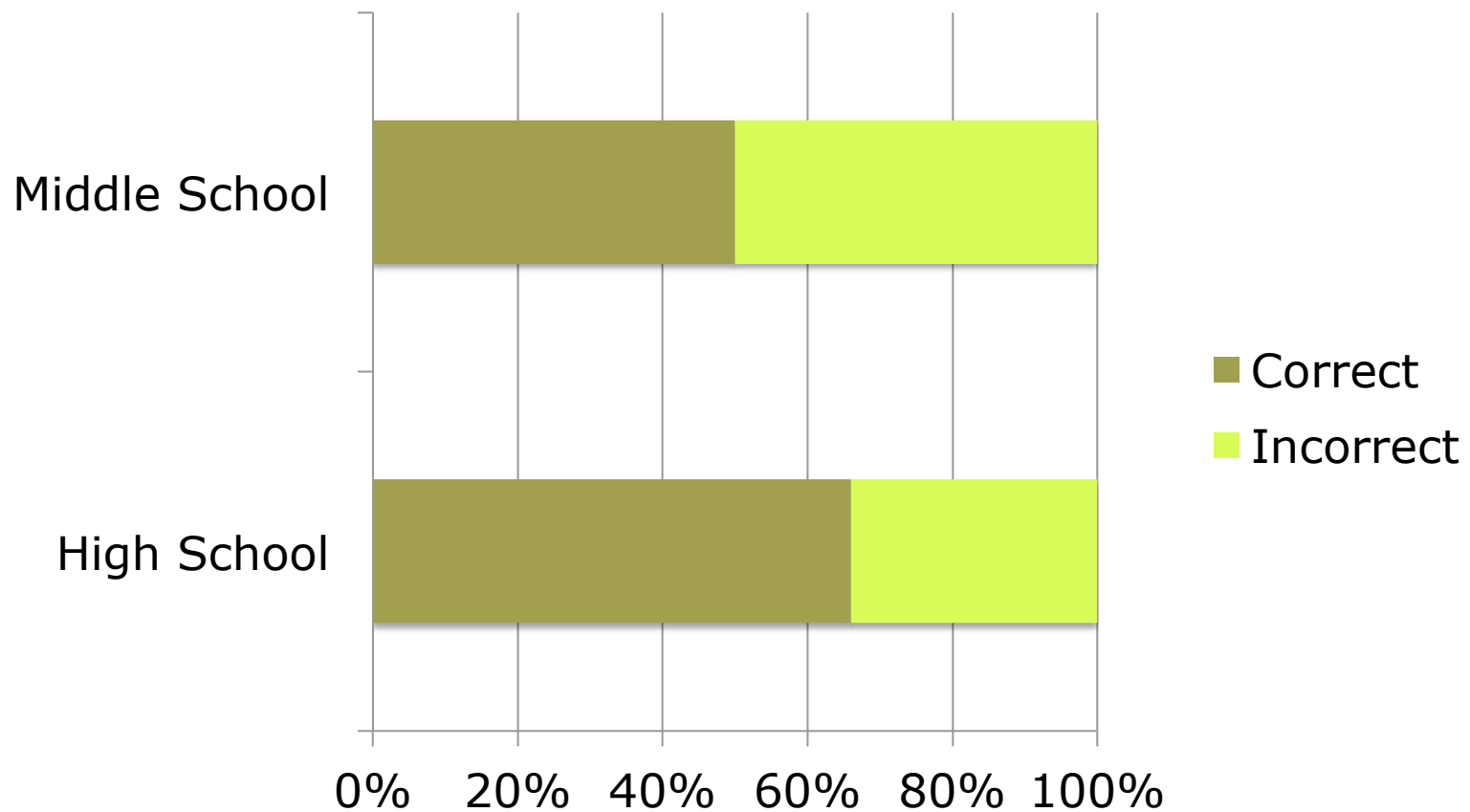
Precision Agriculture



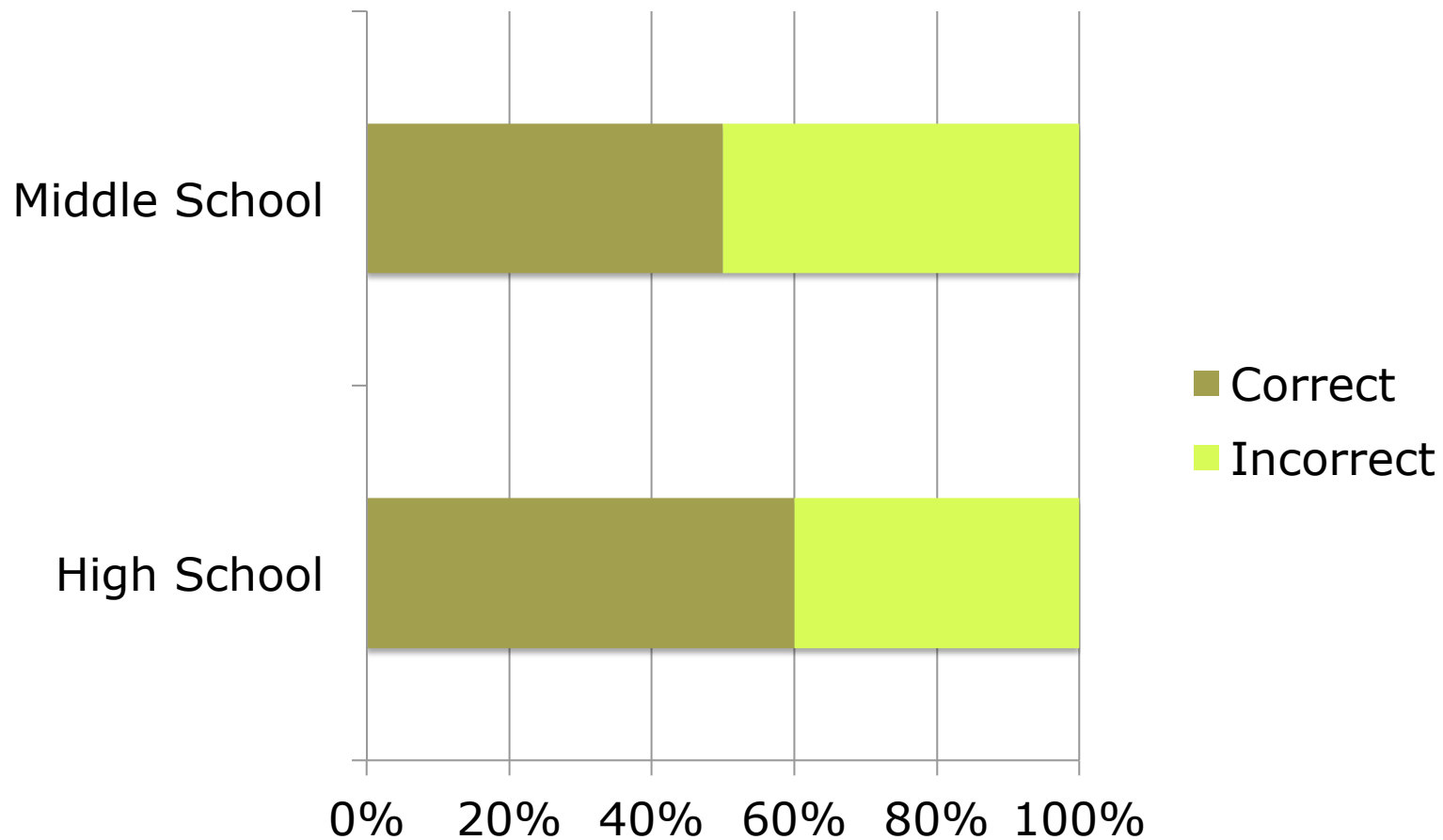
Procedure

- ❑ Add 1/3 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 tea spoon's worth).
- ❑ As you seal the bag, be sure to remove all air.
- ❑ Bring to the front of the room and return to your seat.

What does the term 'renewable energy' mean to K12 Students?



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

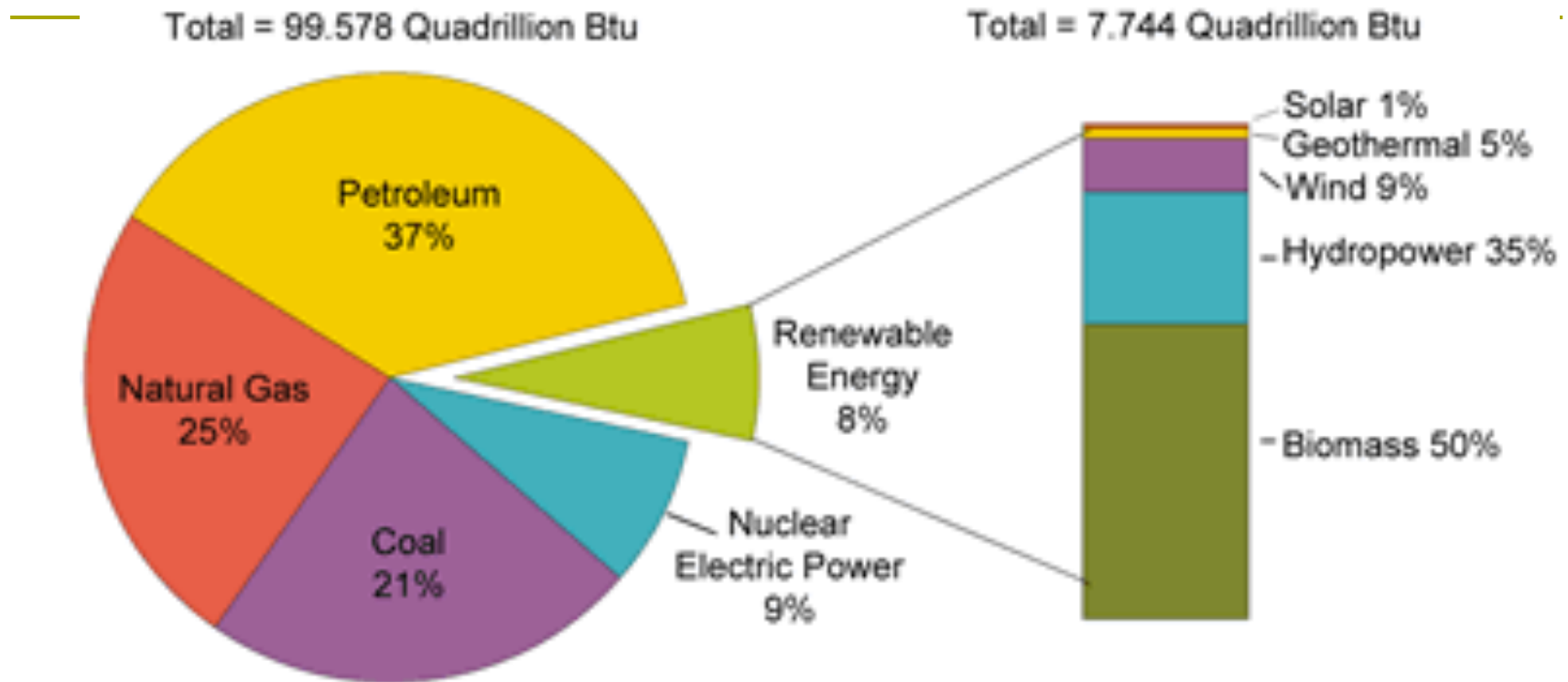


Why Renewable Energy?

- Energy independence
- Reduce CO₂ emission
- Stronger rural economy

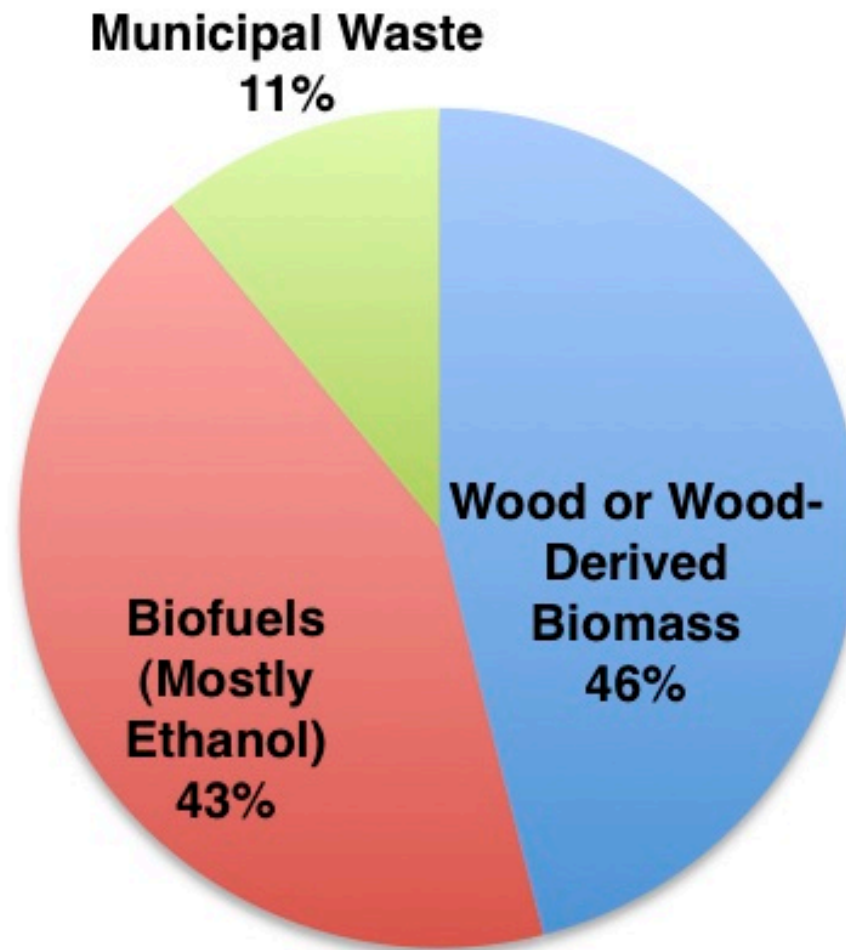


Where does the US get its energy?



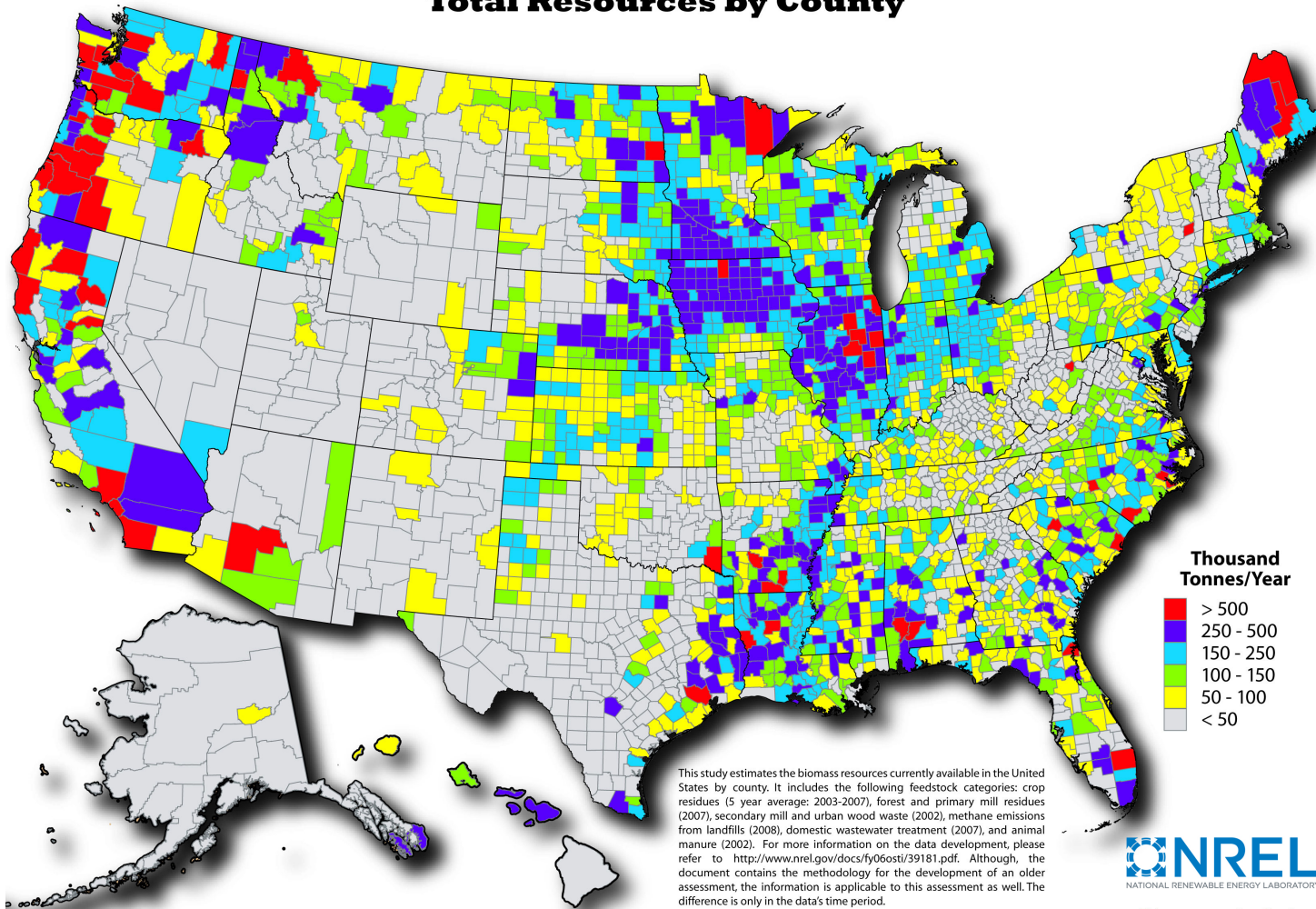
Sources of Bioenergy?

— Sources of Biomass Energy 2010 —



What part of the country has the best woody biomass?

Biomass Resources of the United States Total Resources by County



Is bioenergy practical?



Thermal Conversion

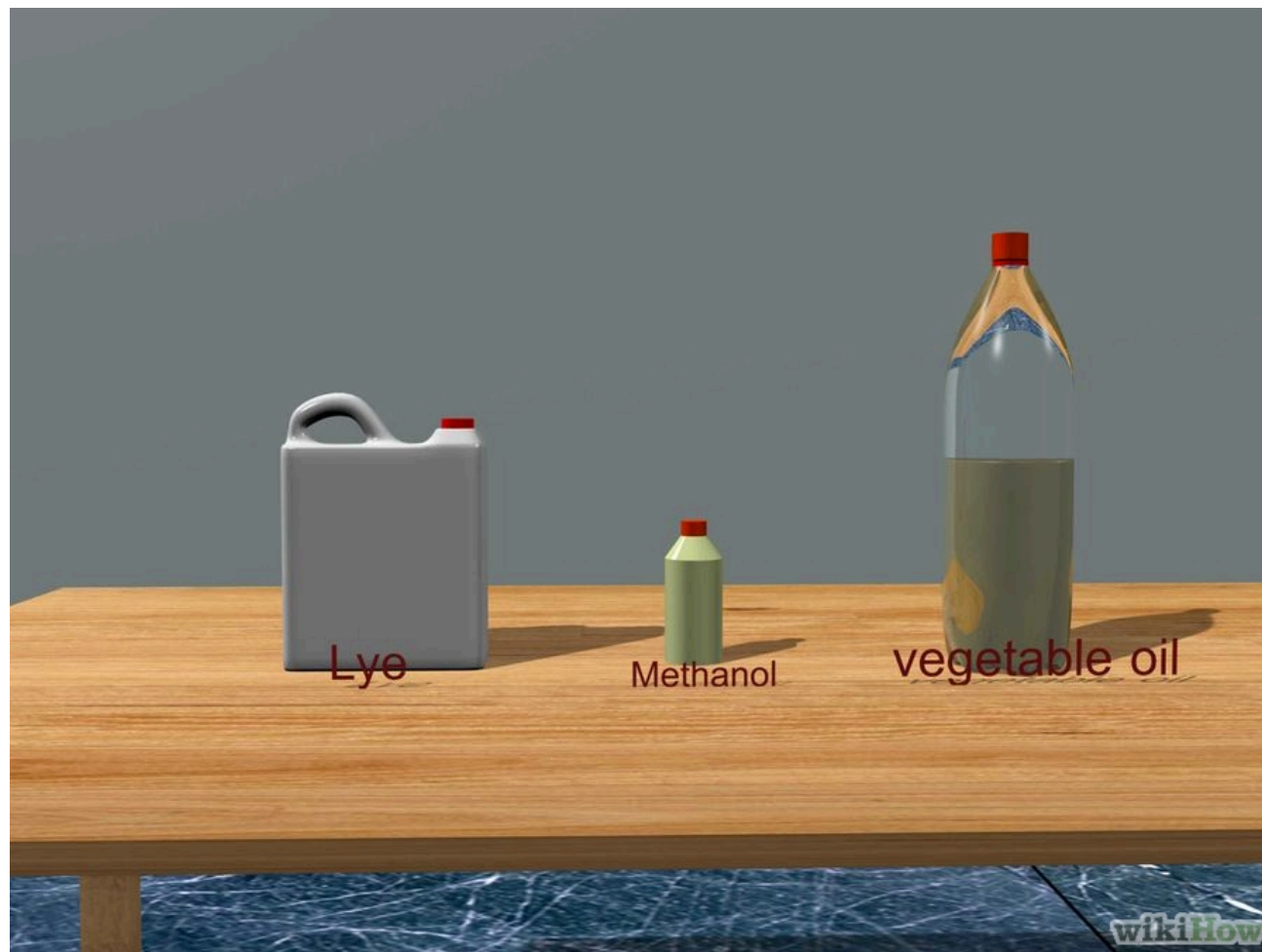


Mechanical Conversion



Chemical Conversions

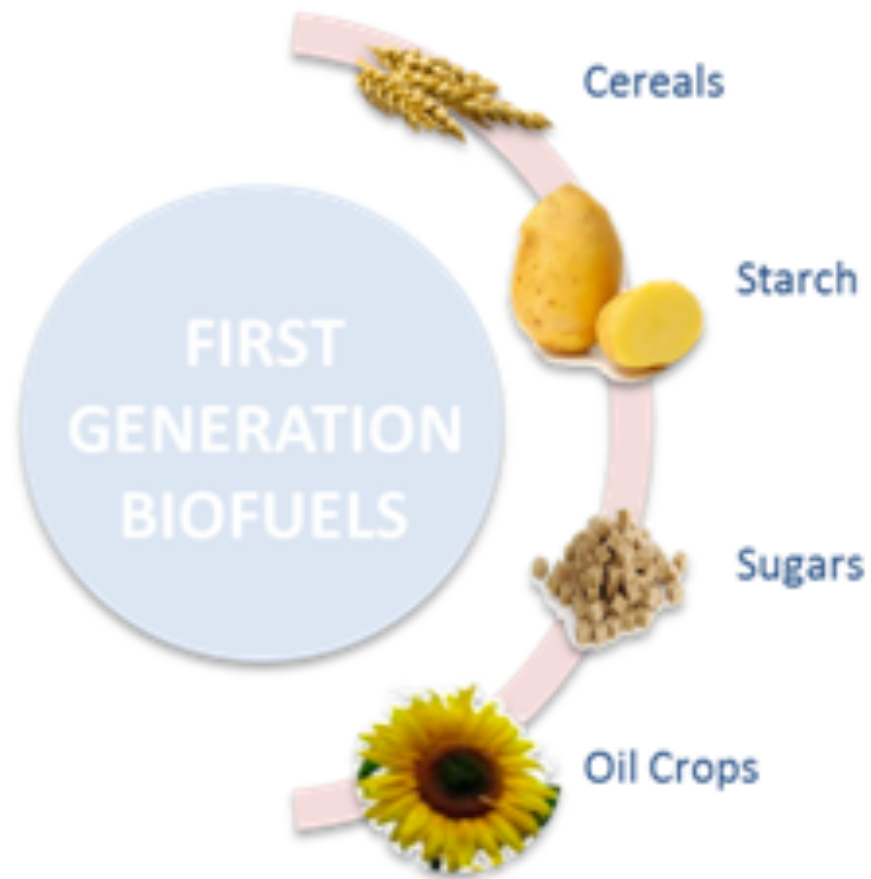
WikiHow: Making Pop Bottle Diesel



What are Biological Conversion?

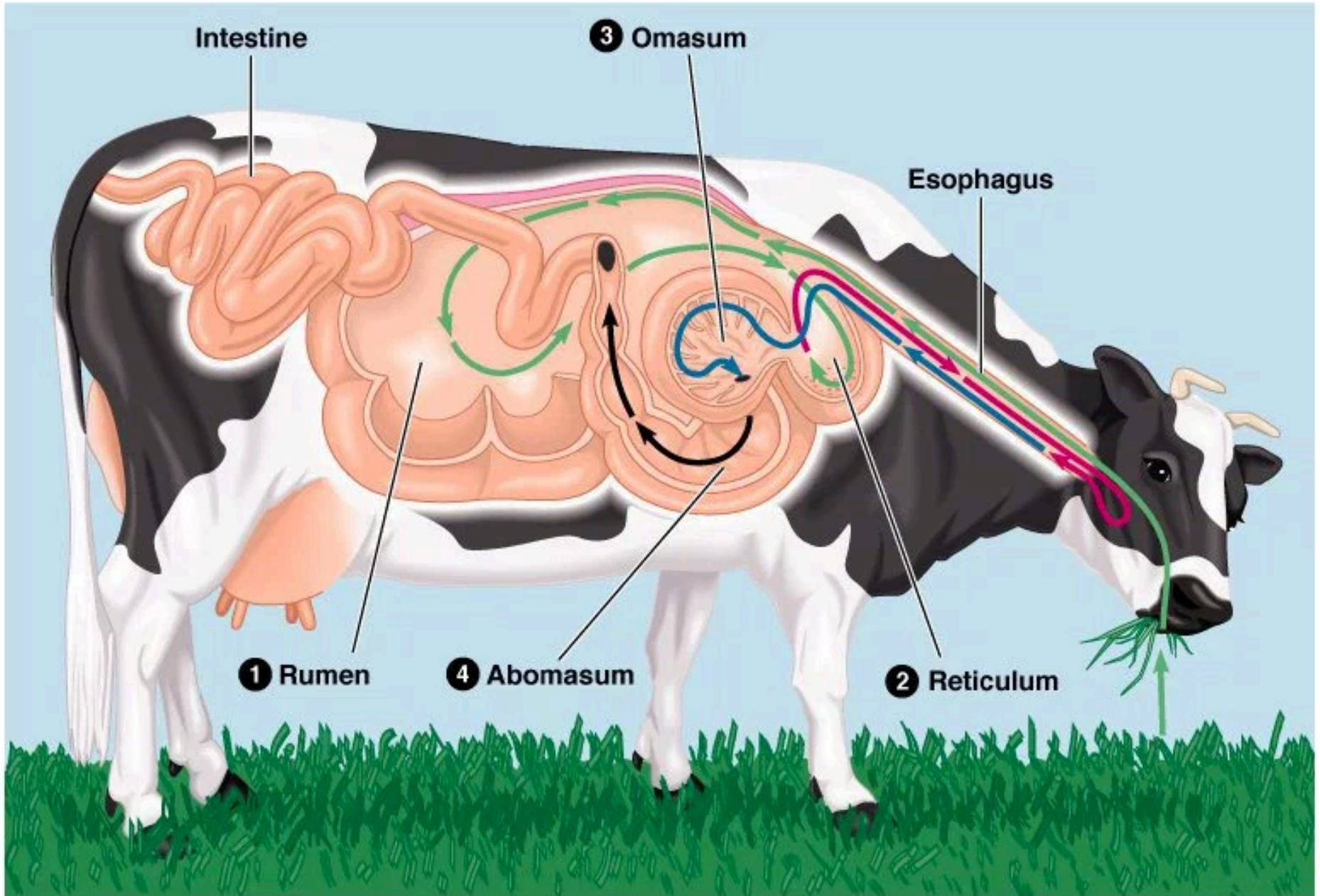


First Generation biofuels



Second Generation Biofuels



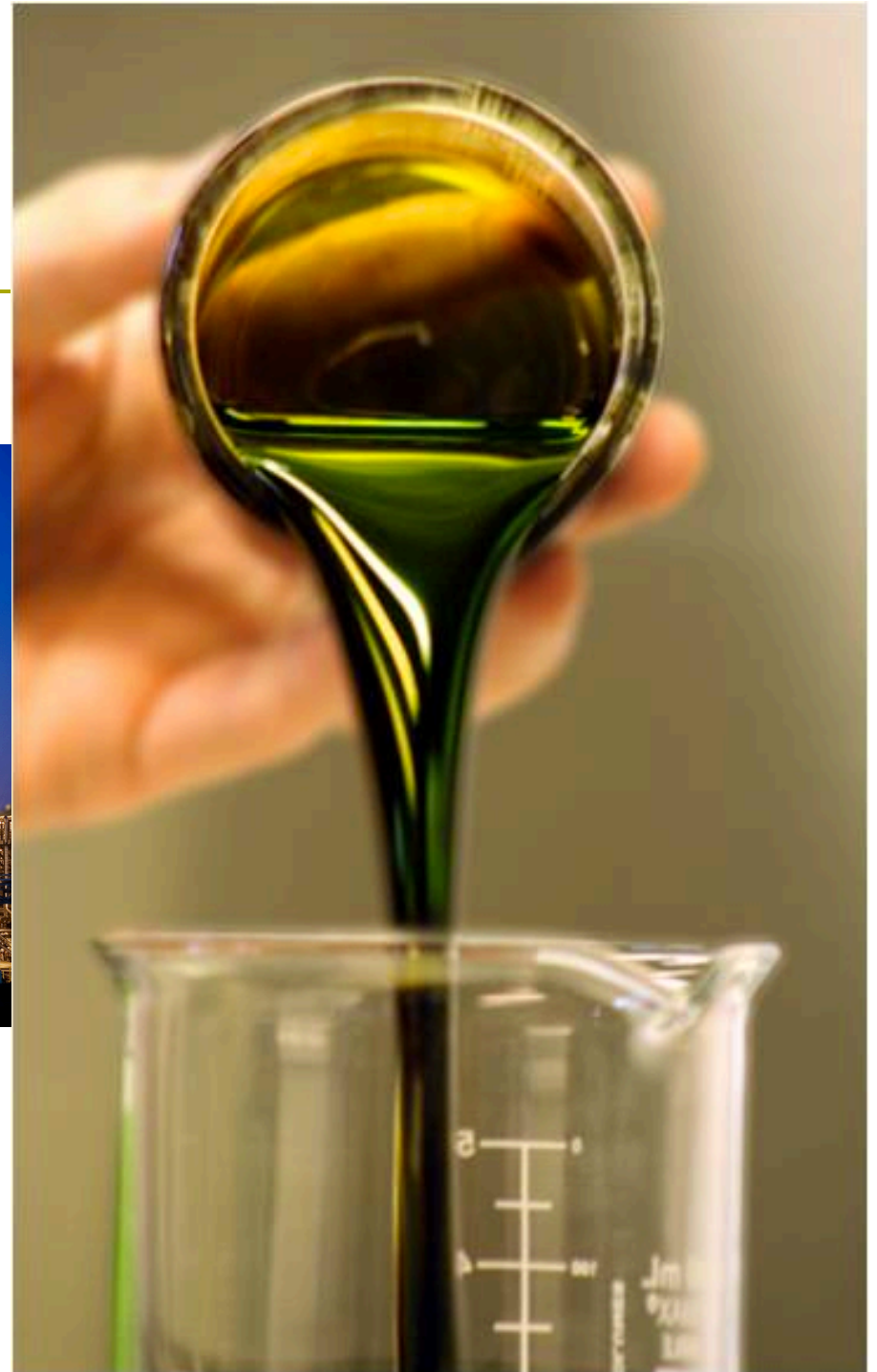


Third Generation Biofuels

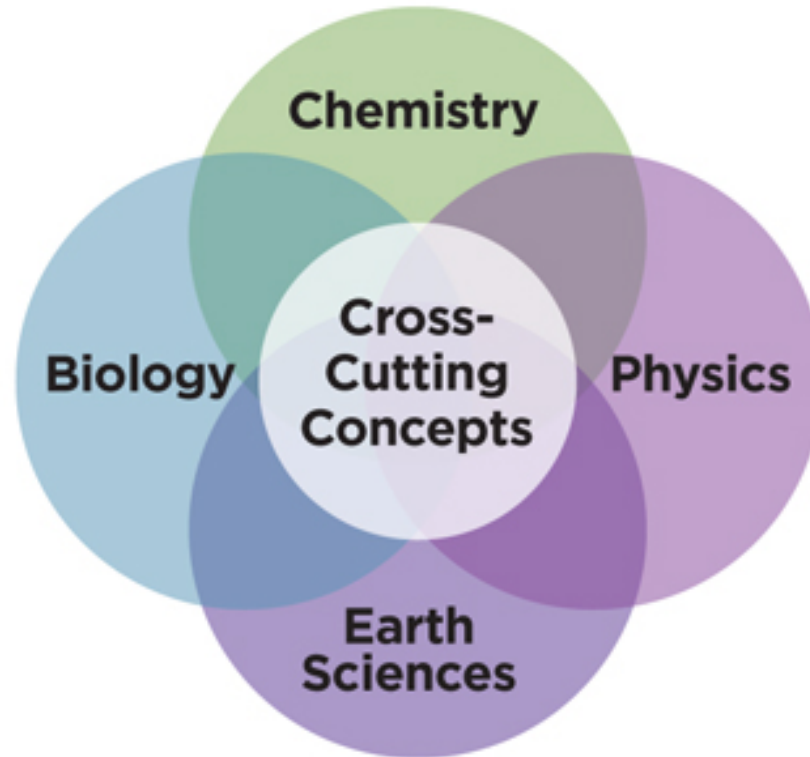


CLOSE X

Green Crude



K12 Bioenergy: What is a Crosscutting Concept?



Rather than siloing, the NGSS include cross-cutting concepts so students can understand how various science disciplines overlap and interact.

Which Materials Do Yeast Digest?

- ❑ Cornmeal
- ❑ Corn starch
- ❑ Wood
- ❑ Sugar
- ❑ Sugar substitutes

What does this mean?

Linking the Yeast Experiment to Bioenergy

- Is yeast plant, animal, or fungi?

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

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

Introducing Bioenergy

First Generation Biofuels

Fermentation

Second Generation Biofuel

Cellulosic Ethanol

Third Generation Biofuels

Algae

Advanced Bioenergy

Microbial Fuel Cell

Bio-products

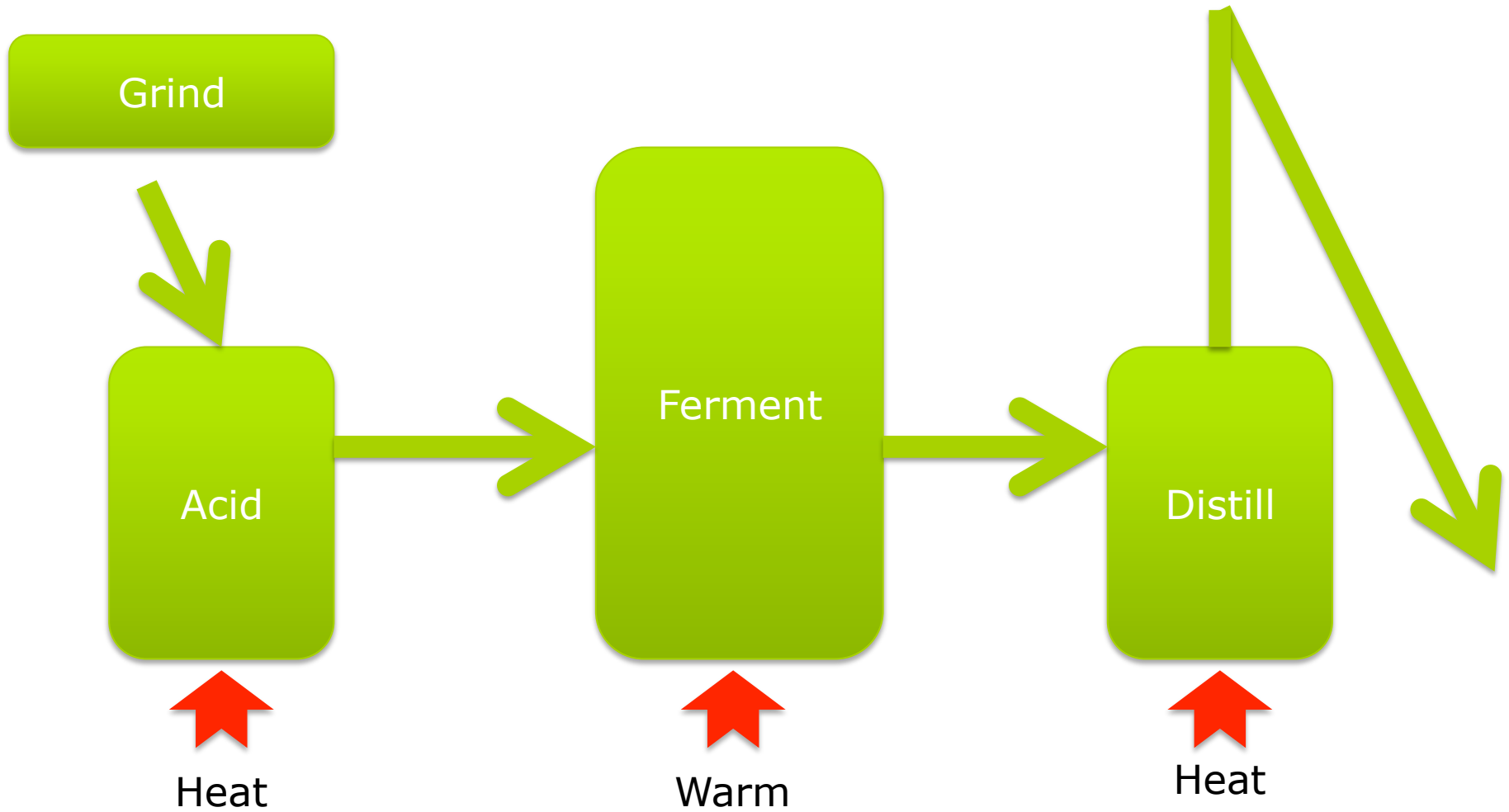
Biodegradable plastics



Biological Engineering

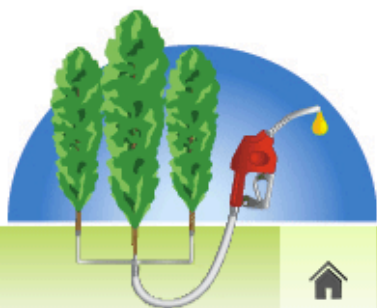
- Is learning fermentation appropriate for K12?
- What factors are required for yeast growth?
- What steps might need to be done to create a recipe for making ethanol?

Ethanol Plant



Where Might Bioenergy Fit?



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Advanced **Hardwood Biofuels** Northwest

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AHB

Advanced Hardwood Biofuels Northwest (AHB) is researching and developing ways to grow and convert hybrid poplars into bio-based chemicals and liquid biofuels.