

# Engineering ethanol in the classroom



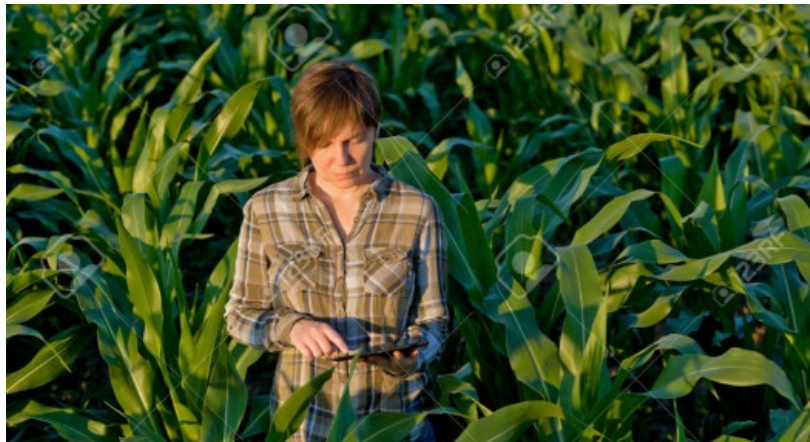
Teaching science through  
the lens of food and fuel.

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# Did you know?

- Kansas has more than 46 million acres of farmland
- There are 60,400 farms in the state and the average farm size is 762 acres.
- Food/agriculture is Kansas' top industry

# Ag-related jobs



# The science in agriculture

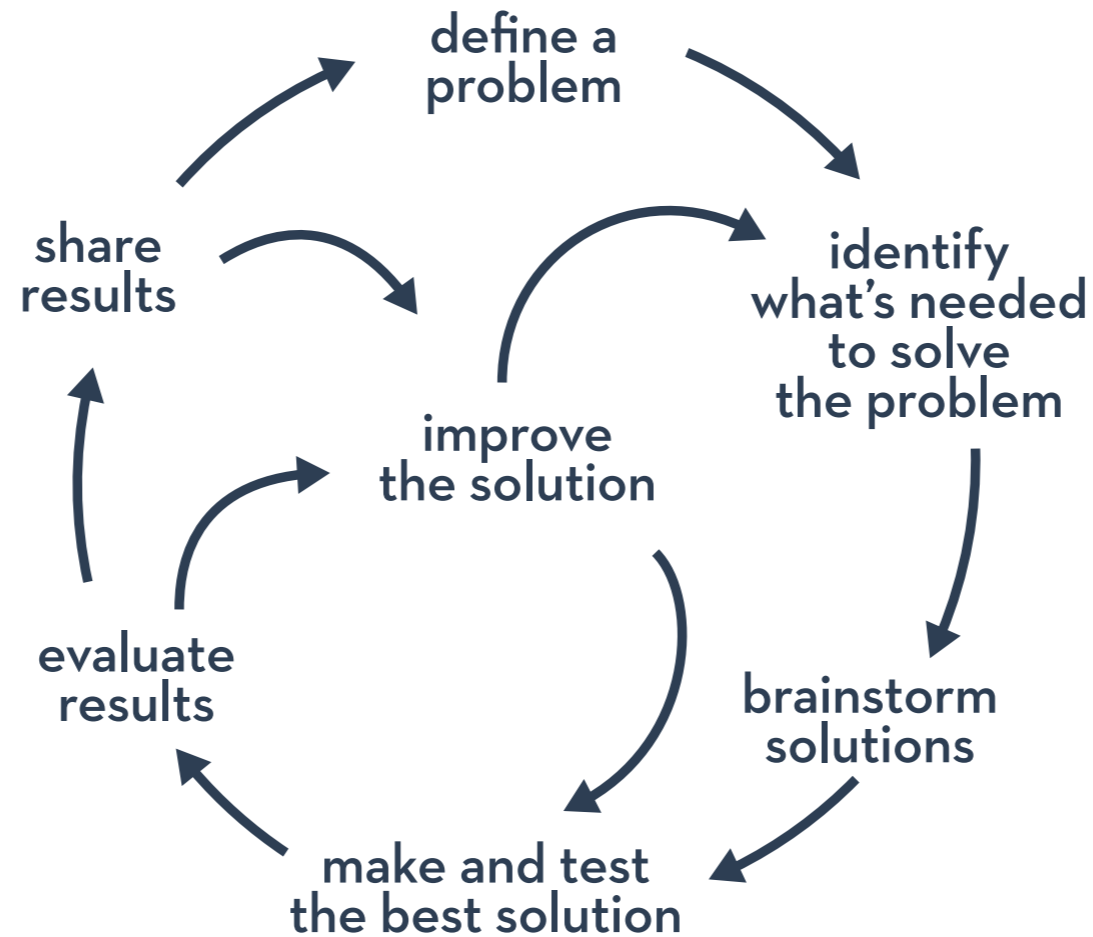
A word cloud of various scientific disciplines related to agriculture. The words are arranged in a roughly circular pattern. The colors of the words are: green (Hydrology, Engineering, Nutrition, Agronomy, Biology, Alternative Energy), blue (Environmental Science, Precision Technology, Chemistry, Forestry, Physics, Entomology, Computer Science, Geology, Mechanics, Mathematics, Animal Science, STEM), and dark grey (Biotechnology, Ecology, Plant Science, Meteorology, Genetics, Soil Science).

Environmental Science   Hydrology   Precision Technology  
Engineering   Biotechnology   Chemistry   Forestry  
Plant Science   Ecology   Physics   Nutrition  
Entomology   Agronomy   Soil Science  
Meteorology   Biology   Computer Science  
Alternative Energy   Genetics   Mechanics   Geology  
Mathematics   Animal Science   STEM

# Essential questions

- Which feedstock material will produce the largest volume of CO<sub>2</sub>?
- How can data/evidence be collected to measure CO<sub>2</sub> gas?

# The Engineering Design Process



# Directions

- In a resealable bag, combine 1 teaspoon of feedstock material, 1 teaspoon of yeast and additional materials of your design choice.
- Add 50 ml of warm water and zip closed, removing as much air as possible.
- Mix gently. Lay the bag flat on the table and measure at 5 minute intervals using the Bag Height Measurement method.
- Record data.
- Plot all data on your graph to measure the fermentation rate of your feedstock(s).



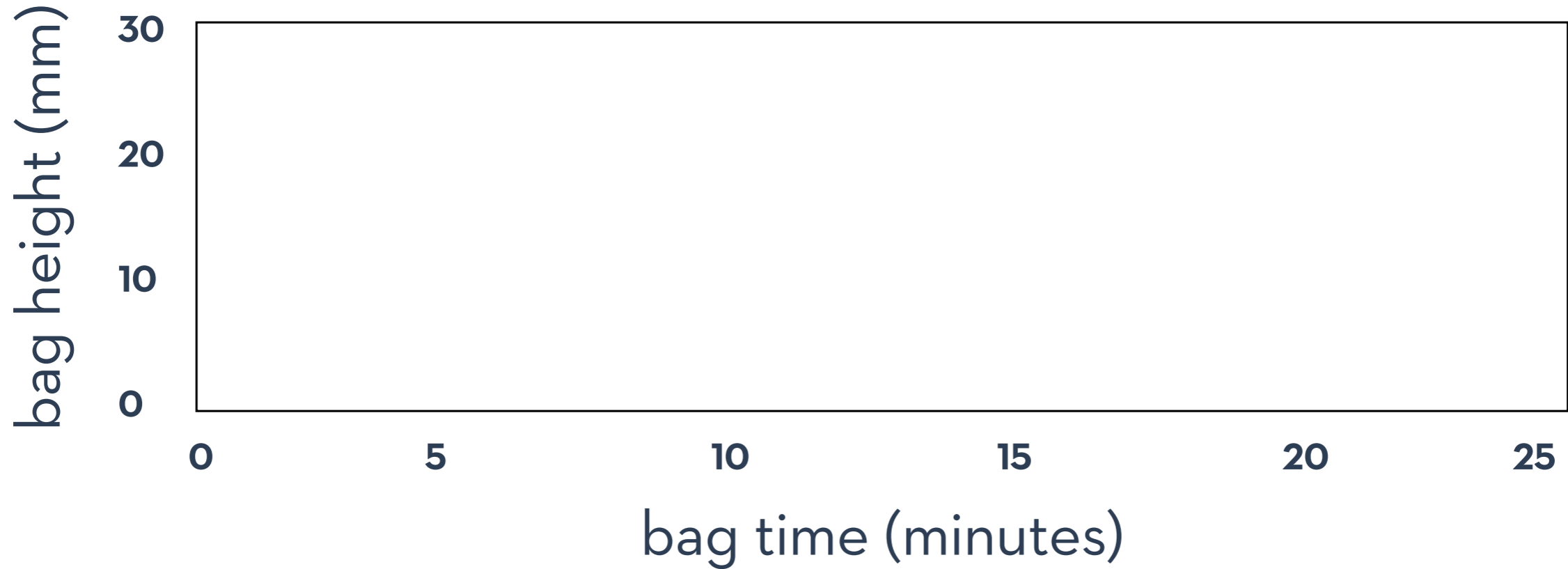
# Measure volume of CO<sub>2</sub>

- Lay bag flat on table
- Place index card on top of bag, parallel to table
- Hold ruler perpendicular to table and record where paper intersects with ruler
- Record in data table every 5 minutes

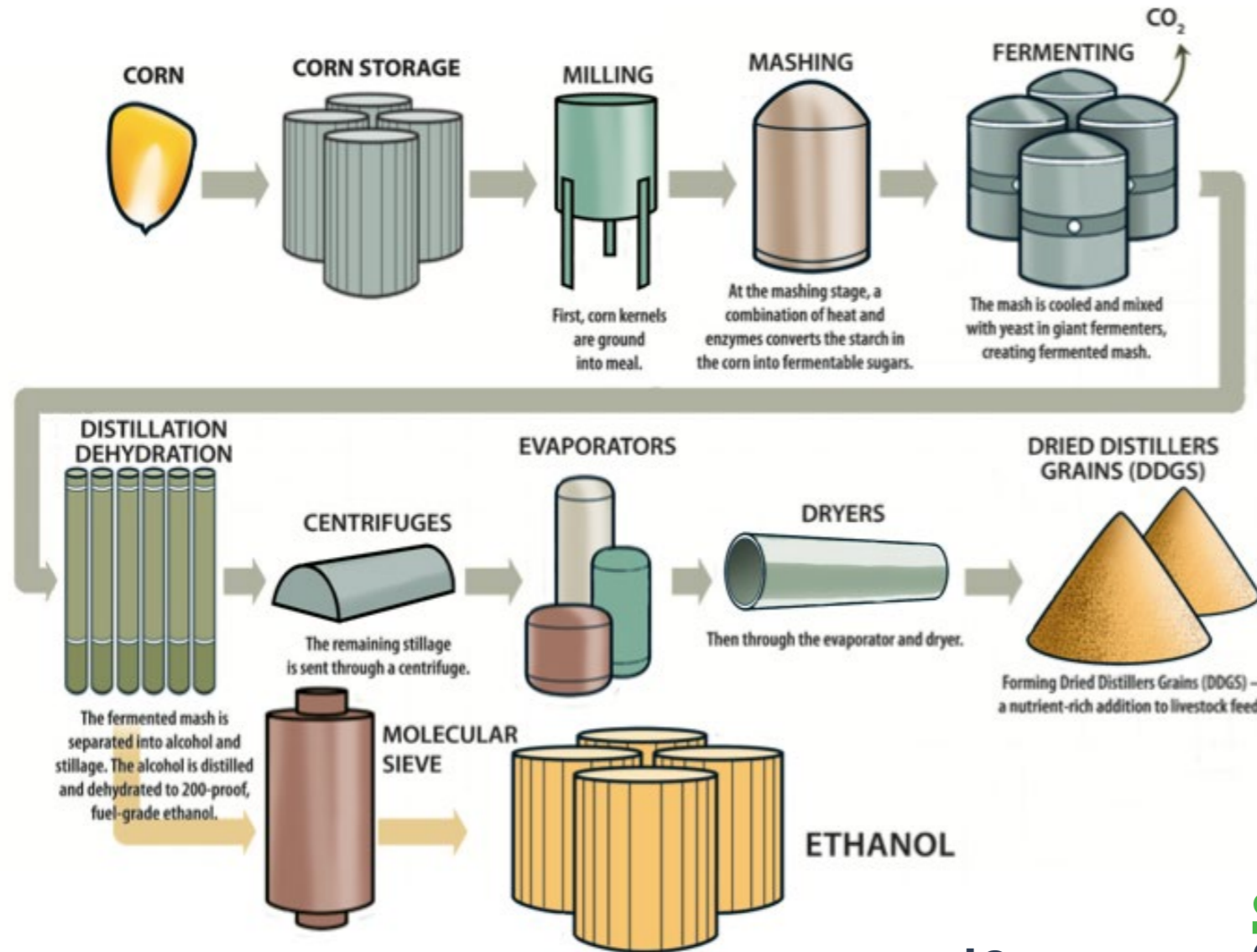
Time (minutes)	Bag height (mm)
0	

Plot all data on your graph to measure slope (rate of fermentation).

### Bag height vs. bag time



# Production process



# Why produce ethanol?

Ethanol is:

- Renewable
- Replaces foreign oil—over 400 million barrels each year—reducing dependence on foreign crude oil
- The by-products can be used to feed livestock, make biodiesel and CO<sub>2</sub> products

# Why produce ethanol?

- Ethanol uses less water to produce than gasoline—2.7 gallons of water for ethanol vs. 97 gallons of water for gasoline
- Reduces greenhouse gas emissions
- Is a net energy gain—produces 3 × more energy than it takes to make it

# Why do we use corn?

- Corn contains a large amount of complex carbohydrates or starch (70%)
- This starch can be broken down easily into simple sugars that yeast can then ferment.
- One bushel of corn produces approximately 2.8 gallons of fuel grade ethanol
- About 40% of US corn is used to make ethanol

# Thank you!

@seed2stem

@kscorn

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@OH\_EPP