



Fermentation in a Bag

The Investigation

The problem: How to make fuels from plants?



Ethanol

Ethanol is produced by yeast and other microbes. Yeast is:

- ✦ a type of fungus.
- ✦ added to bread dough to make it rise.
- ✦ used to make ethanol (ethyl alcohol) in alcoholic drinks such as beer and wine.

Yeast performs a process called **fermentation**. We are going to observe yeast fermenting **different sources of plant sugars**.



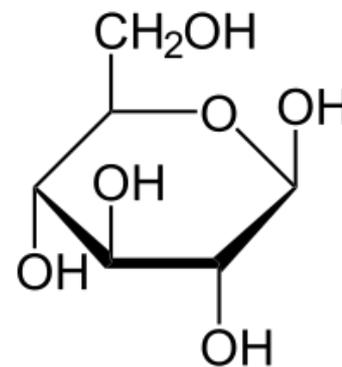
Sources of plant sugar

- ✦ Glucose
- ✦ Starch
- ✦ Cellulose

Glucose



- ✧ Sugar dissolved in plant juices
- ✧ Makes them taste sweet
- ✧ Sugar cane is a source for table sugar



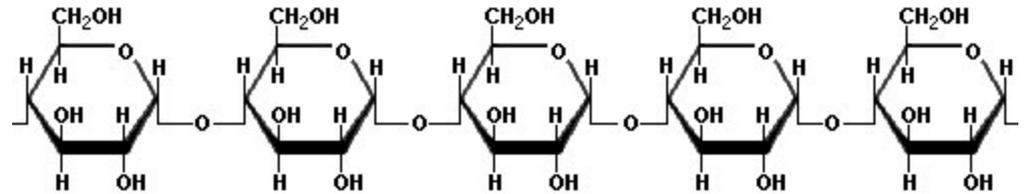
Glucose molecule

Starch

- Starch is a polymer of sugar.
- Corn kernels contain a lot of starch that is easy to extract.



Starch Molecule



Glucose molecules bent into rings and linked together



Sources of starch

- ✧ Corn starch
- ✧ Tapioca or rice starch
- ✧ Flour



Cellulosic biomass

Cellulose

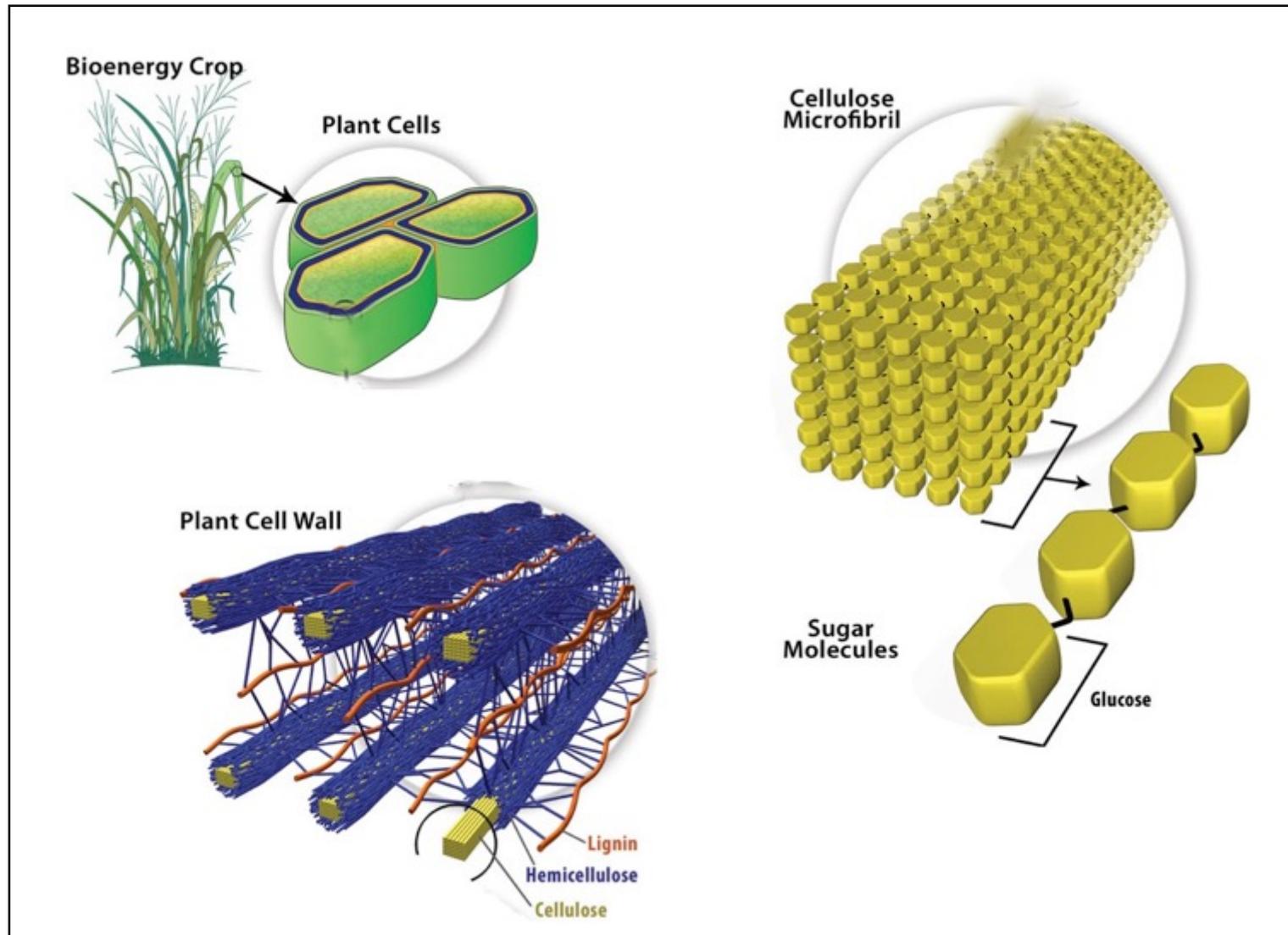
- ✦ A polymer of sugar that makes up much of the walls of plant cells
- ✦ Why plants can stand upright
- ✦ Most abundant molecule on earth

Sources of cellulose

- ✧ Corn stalks, leaves, and husks (stover)
- ✧ Grasses grown as crops
- ✧ Prairie grasses
- ✧ Sawdust and woodchips
- ✧ Yard waste
- ✧ Any plant!



Cellulose structure



Fermentation in a Bag Procedure



- ✧ 1 teaspoon of plant material
- ✧ 1 teaspoon of yeast
- ✧ 50 mL of warm water
- ✧ Remove air from bag and seal

Questions for Fermentation in a Bag Investigation

- ✦ What chemical changes occur during fermentation?
- ✦ Are there differences in how well yeast can ferment different sources for plant sugar?

Fermentation in a Bag: Protocol

1. Label your bag
2. Add 1 tsp of chosen plant sugar source (biomass)
3. Add 1 teaspoon of yeast
4. Add 50 mL warm water, mix & seal
5. Observe and measure changes over time



Planning and Making Predictions

- ✦ What changes, if any, do you expect to observe & measure? Explain.
- ✦ Do you expect to see any differences in observations between food sources that your class is comparing? Explain.

Chemical changes: What was in the bag before and after fermentation?

Stage	What's in the bag?	Evidence	Explanations
Before			
After			

Comparing sugar sources

Sugar source	Observations	Explanations
Sugar		
Starch		
Cellulose		