Alternative Energy

OVERVIEW:

In this activity, students will observe that the cost and the demand for fuel are directly related to the increase in the population. Students will compare and contrast China's land resources, population, energy resources, and food resources to the United States and identify alternative fuels that will help the United States with its energy conservation.

CONCEPTS:

National Science Foundation Standards:

Standard F: Science in Personal and Social Perspectives

(Populations, Resources, and Environments):

- Causes of environmental degradation and resource depletion.

Benchmark 4: The Physical Setting

B: The Earth

- Some minerals are very rare and some exist in great quantities, but-for practical purposes-the ability to recover them is just as important as their abundance.
- As minerals are depleted, obtaining them becomes more difficult. Recycling and the development of substitutes can reduce the rate of depletion but may also be costly.
- The benefits of the earth's resources-such as fresh water, air, soil, and trees-can be reduced by using them wastefully or by deliberately or inadvertently destroying them.
- The atmosphere and the oceans have a limited capacity to absorb wastes and recycle material naturally.
- Cleaning up polluted air, water, or soil or restoring depleted soil, forests, or fishing grounds can be very difficult and costly.

OBJECTIVES:

Students will:

- Identify alternate fuels and how they can be used for energy conservation
- Observe how ethanol is made.
- Identify the uses of petroleum fuel
- Compare and contrast China to the United States energy and land usage
- View a video about China's population and energy resources

PROCEDURES:

- Allow 2-3 hours to present the background information and to complete the activity.
- Show video: World Population
- Present the background information.
- Complete the activity (Part A.)
- Follow up activity with discussion questions (see Part B.) These questions may be used for assessment purposes.

MATERIALS:

- Background information

- Transparency (2) or student handout (see attached)
- Transparency Masters (to use while presenting background information)
- Video: "World Population" by Population Connection
- Corn items: (for display)
- Popcorn
- Corn meal
- Corn starch
- Corn syrup
- Corn oil
- Cereal
- Corn chips
- Toothpaste
- Apple (one for demonstration purposes or one apple per group of four students)
- Knife
- Paper towels
- Game (www.bae.uky.edu/biofuels)

BACKGROUND:

From the video we have just watched, it is clear that there has been massive population growth since the 1900's, especially in China. Let's move on and compare the populations in China and the U.S.

You can see that we have the same amount of land, but China seems to have more people. We have more natural resources per person than they do. Compare this:

LAND RESOURCES	LAND RESOURCES
9.12	9.6
30 people per square kilometer	127 people per square kilometer

We eat more calories than they do, because their diets are mostly comprised of vegetables. They also have less money, use less electricity, and less petroleum per person.

What is petroleum and what is it used for? A long time ago, the American Indians used the black sticky substance for war paint and as an insulation material. It had also been used for light emission and water proofing. However, it wasn't until the 1870's that it was discovered as a source of fuel. The first one was called "kerosene" which could be isolated from crude oil. Besides being processed and being used for fuel sources, petroleum can also be a source of a wide range of organic compounds like plastics, synthetic textile fabrics, synthetic rubber products, pharmaceuticals, dyes, etc.

Petroleum can also be a source of pollution by emission of gases like Carbon Monoxide and Carbon Dioxide. It can also damage aquatic and bird life through oil spills and oil leaks from pipelines in the ocean water.

The big question is why does this country rely so heavily on petroleum? The main fact is that crude petroleum is in liquid or suspended matter form, and in this form it can

be easily pumped onto the surface using oil well rigs. Once out, it can be easily and inexpensively be transported through pipelines.

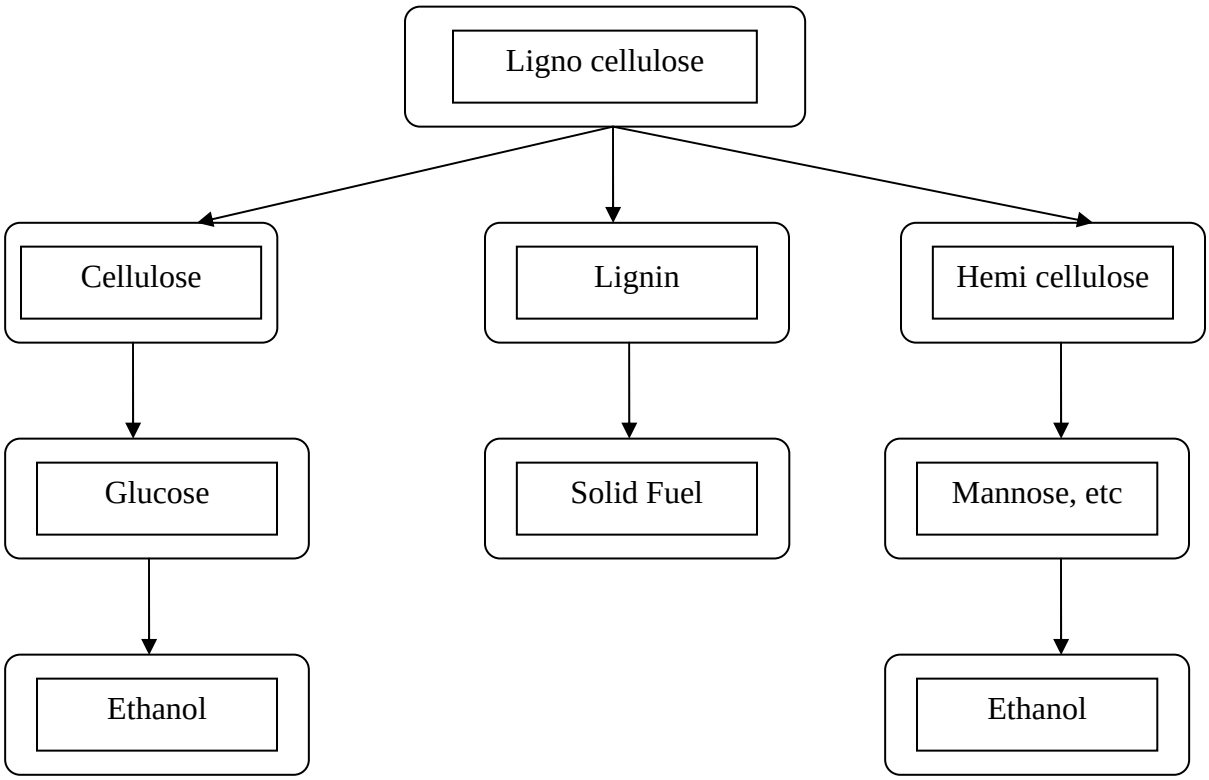
With the hike in gas prices, the question we should be asking ourselves is what other form of fuel we can use to power our cars, which is inexpensive and readily available. Can we use the Sun? Water?

Look at a corn kernel. What products in the market do you know about that are made from corn? Examples: popcorn, corn meal, corn starch, corn syrup, corn muffins, corn oil, cereal, corn chips, toothpaste, and ethanol.

What is ethanol? Ethanol is also known as ethyl alcohol or grain alcohol. As more and more Americans are becoming more aware of the environmental impacts of petroleum use, interest in alternative fuels like ethanol is increasing. Like gasoline, ethanol contains hydrogen and carbon, but ethanol also contains oxygen, which make it a cleaner burning fuel than gasoline. Ethanol can be produced chemically from ethylene or biologically from grains, agricultural wastes, or any material containing starch and sugar. Because Ethanol can be produced from crops, it is known as a renewable fuel.

In the U.S., ethanol is produced mainly from corn in the Midwest. One bushel of corn (approx. 56 pounds) produces 2.7 gallons of ethanol, 12.4 lb of protein feed, 3 lb of gluten meal, 1.5 lb of corn oil, and 17.0 lb carbon dioxide. At the moment in this country, only 10% ethanol blended in gasoline is what is widely available. This 10% ethanol (E10) is added in order to fulfill federal oxygenate requirements.

There is not enough land in the U.S. to cater for the food and fuel needs of everyone. It would take 1/3 of the corn crop. Not all areas of the country can take any more farming, especially because only top soil is good for growing crops. But think about this, what if we used the corn for food and then tried to produce ethanol from the rest of the plant, as shown below:

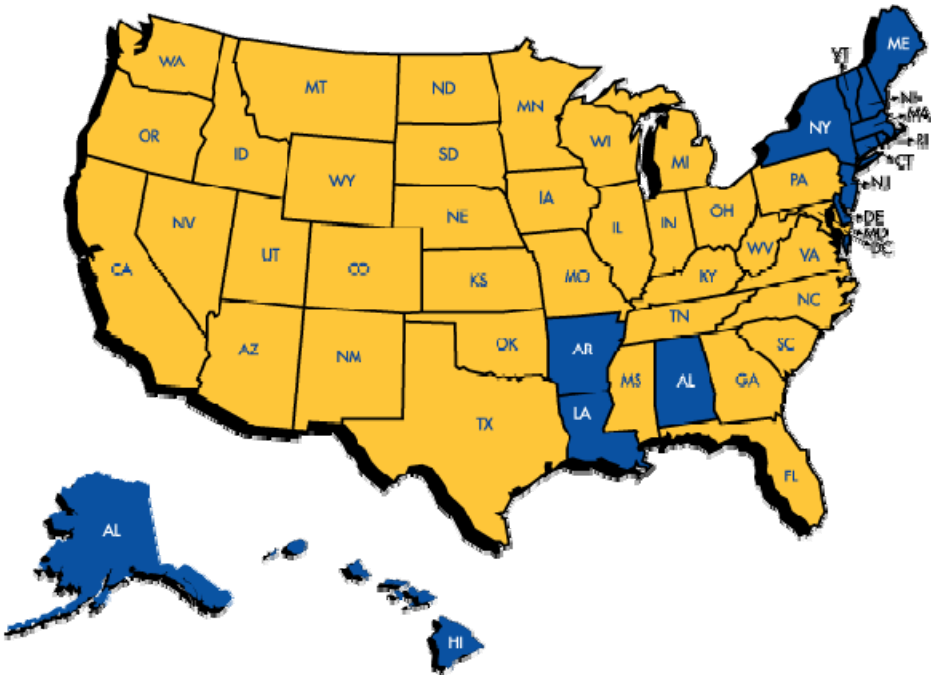


This is something that can be done, and more so will also help preserve the land and make use of the whole corn plant. In doing this, we will improve on production and hopefully be more self reliant as far as fuel goes because we will be suing a renewable resource that is readily available.

Another Ethanol fuel that is gaining popularity here in the U.S is E85. E85 is 85% ethanol and 15% gasoline. This fuel is only compatible with specially made vehicles that are flexible fuel vehicles (FFV's). These FFV's are capable of operating on gasoline/ethanol blends with up to 85% ethanol. In case of any shortage of if the owner has traveled to an area without E85, the vehicles can take any other gasoline available. If your vehicle is not listed, your vehicle is NOT E85 compatible.

- Daimler Chrysler
- Ford
- General Motors
- Isuzu
- Mazda
- Mercedes
- Mercury
- Nissan

E85 is available in most states as shown in yellow in the map below.



Here in Kentucky, there are 2 gas stations that serve E85 one is located in Hopkinsville, while the other is located in Louisville.

Benefits of E85

1. It is easy to use and handle
2. It reduces petroleum consumption
3. It is good for the environment
4. Flexible Fuel Vehicles (FFV's) are available and affordable

5. FFV's have flexible fueling options – meaning that they can take any other type of fuel in the absence of E85.

ACTIVITY:
Part A:

Activity 1: Video: World Population

Materials:

- Video: "World Population" by Population Connection

Directions:

1. Introduction to the video:

We're going to watch a short video. Pay attention to the lights. Each light represents 1 million people. Notice where the lights are. Where should they start? Where were the first people? [Africa] When was the plague? [1300's] Watch Europe during that time period. When would you expect to see lights in North America?

2. Watch the video.
3. Follow up to the video:

Ask students what they thought of the video. What is the message?

Explanation of Video: The message is that population grows exponentially not linearly. The rate of increase in population is very apparent when using lights.]

Activity 2: Apple Planet

(Can be a teacher demonstration or students can works in pairs/small groups.)

Materials:

- Apple (one for demonstration purposes or one apple per group of four students)
- Knife
- Paper towels

Directions:

After participating in this activity, the student will deduce that only a small fraction of the Earth supports all human life.

- Earth: The Apple of Our Eye (2002 Population Connection)

http://www.populationeducation.org/media/upload/earthApple_nov2002.pdf

Or

- Visual Model of the Planet Earth

http://www.eduref.org/Virtual/Lessons/Science/Earth_Science/EAR0023.html

Activity 3: Energy Game (www.bae.uky.edu/biofuels)

Students will play a board game designed to

a) quiz students on important renewable energy issues
b) force players to make energy decisions
c) give students ideas about how to be more conservative with energy
d) emphasize the inter-connection between resources.

Go to the website listed above (under Teacher Resources) to get materials, instructions, questions, rules, game board, and preparation.

Part B:

Ask the following questions and allow time for discussion.

Share:

What are the benefits of using ethanol as an alternate energy source?

Process:

Why is looking for alternate energy sources a high priority?

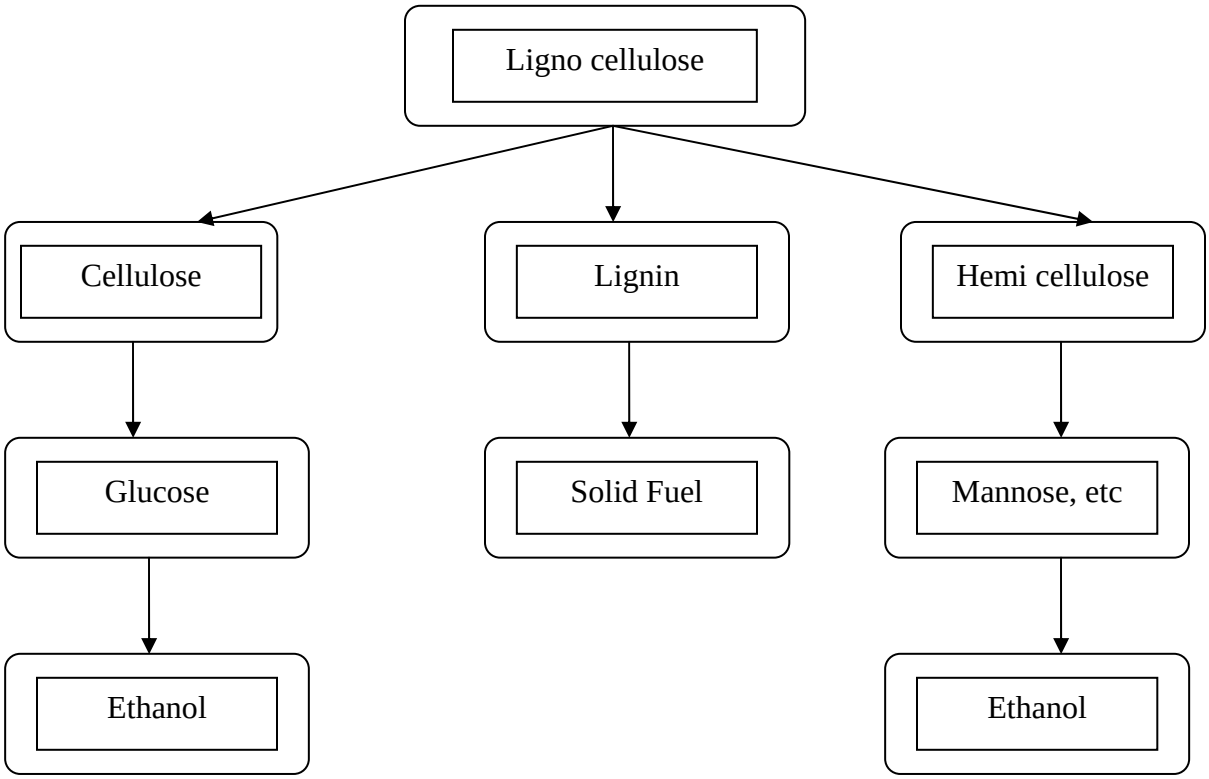
Generalize:

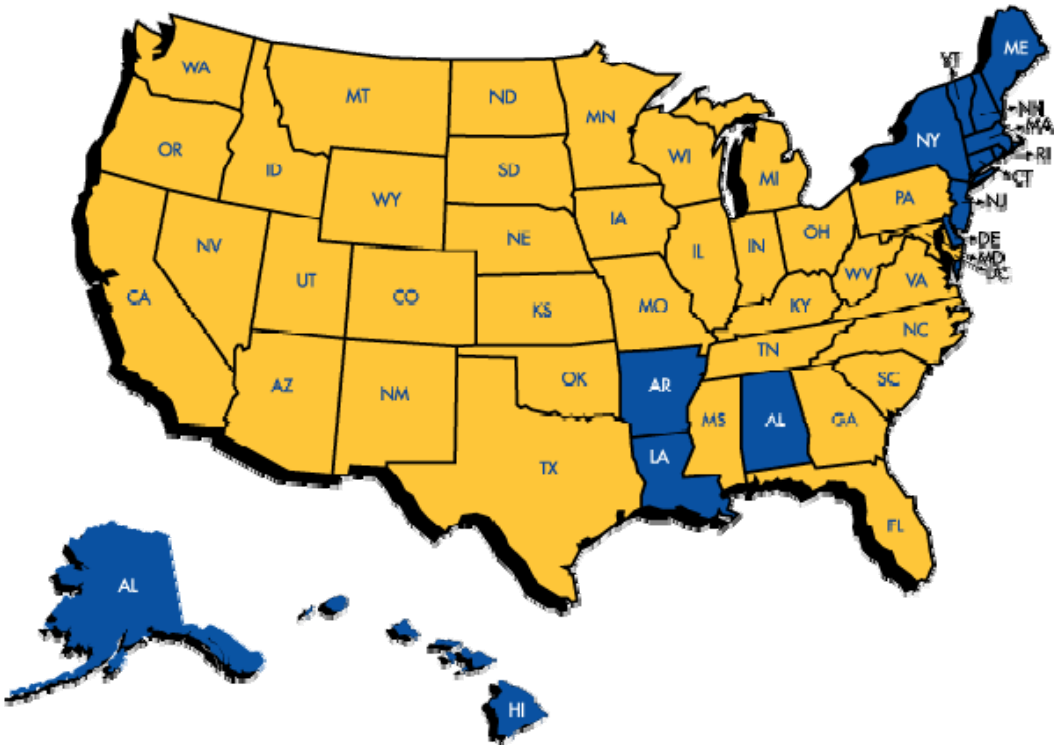
Why are gas prices high?

Apply:

As populations increase, the demand for fuel increase, and the cost of fuel increase, how will your life be affected?

(Make transparency or give as handout to students.)





Transparency:

Corn

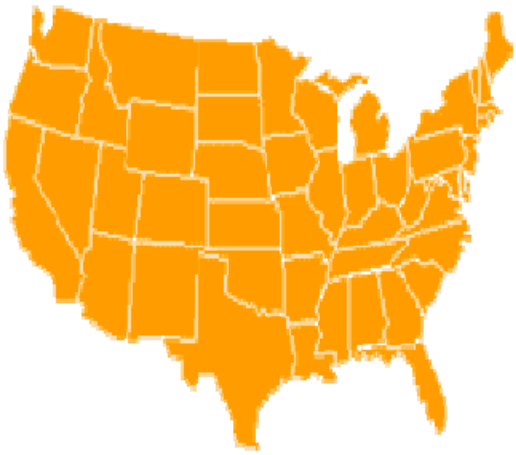
U.S. vs. China Population

- 278,000,000 people
- 30 people/ km^2

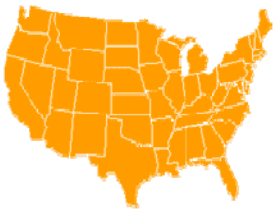
- 1,270,000,000 people
- 132 people/ km^2

U.S. vs. China Land Resources

- 9.12 M km^2

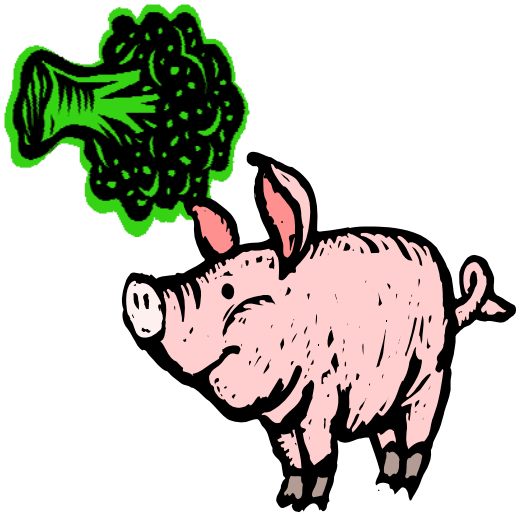


- 9.6 M km^2

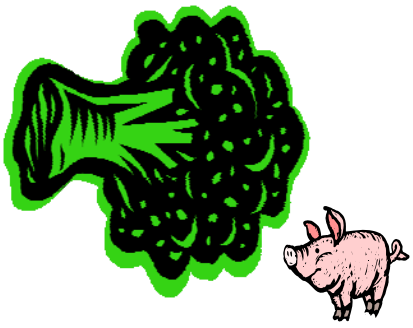


U.S. vs. China Diet

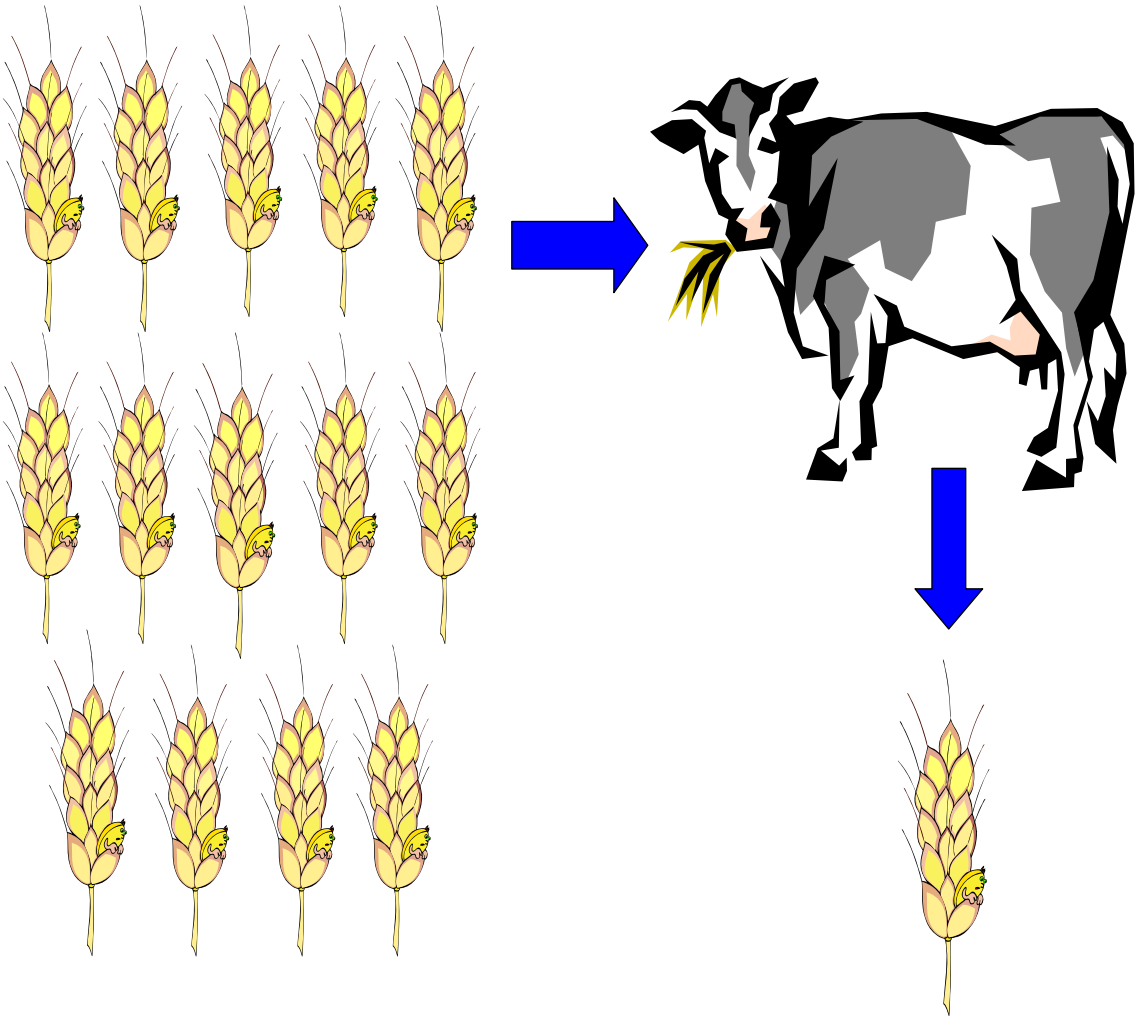
- Caloric intake - 4100 kcal/day
  - 37% vegetable protein
  - 68% animal protein



- Caloric intake - 2800 kcal/day
  - 68% vegetable protein
  - 32% animal protein



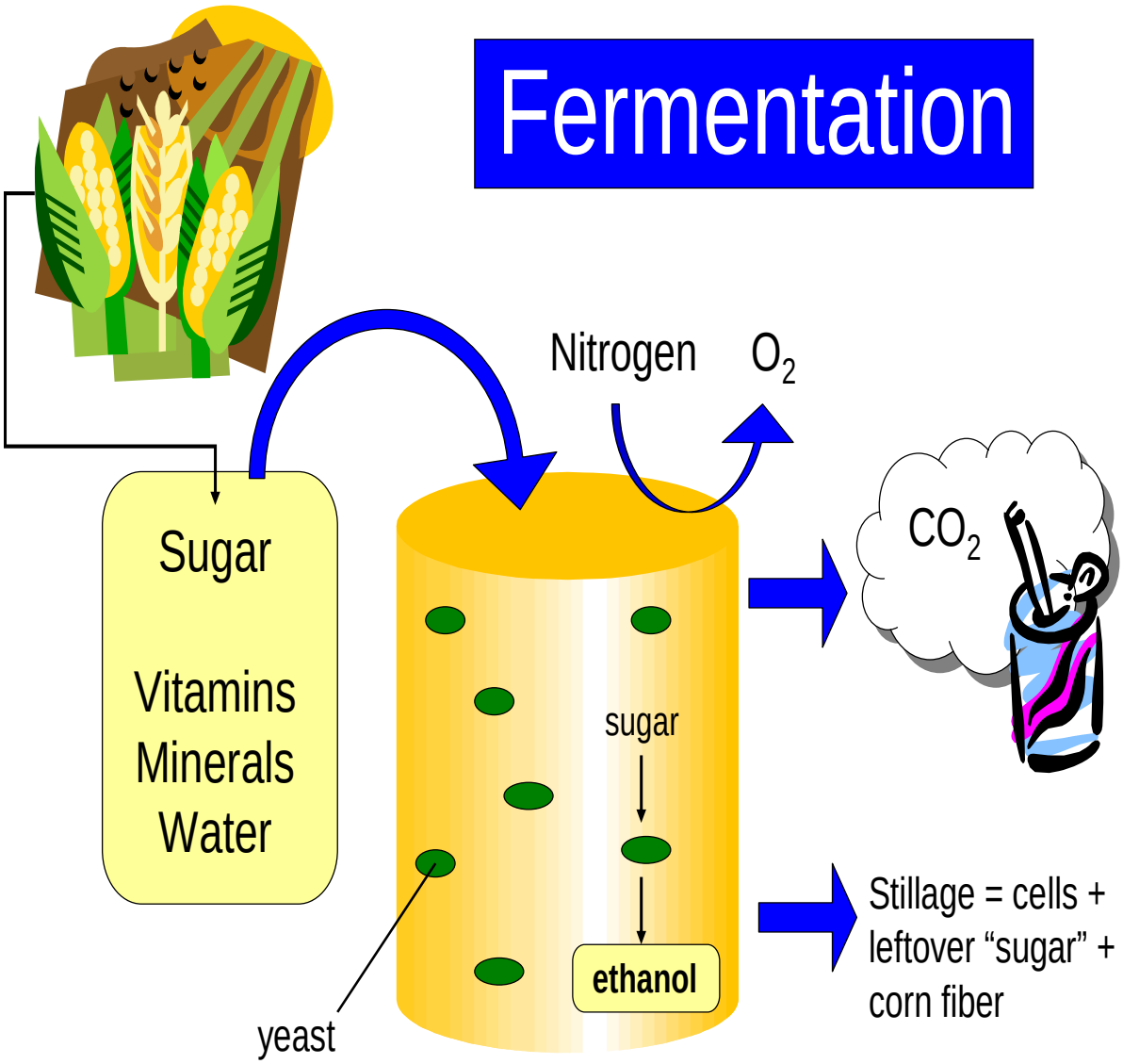
You have to feed 14 times as much protein to an animal as the amount that you get from it as meat.

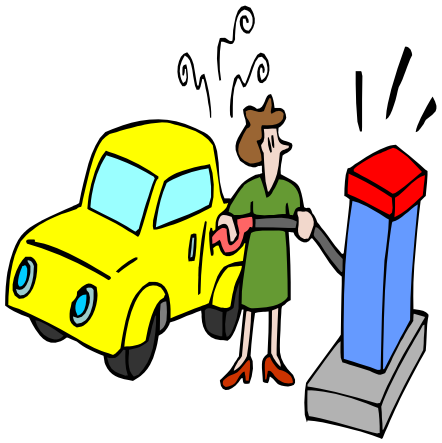


U.S. vs. China Energy

- $36,200 per capita GDP
- 12,400 kWh/person annual electric use
- 25.9 barrels/person annual petroleum use

- $3,600 per capita GDP
- 850 kWh/person annual electric use
- 1.3 barrels/person annual petroleum use


Fermentation
Nitrogen
O_2
Sugar
Vitamins
Minerals
Water
sugar
ethanol
yeast
CO_2
Stillage = cells +
leftover “sugar” +
corn fiber

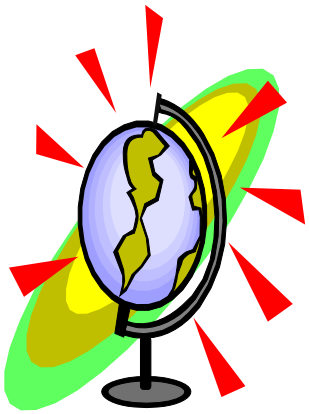


The United States transportation system uses 609 million gallons of petroleum PER DAY!

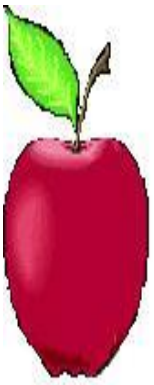
10% Ethanol Blend = 60.9 millions of gallons of ethanol per day

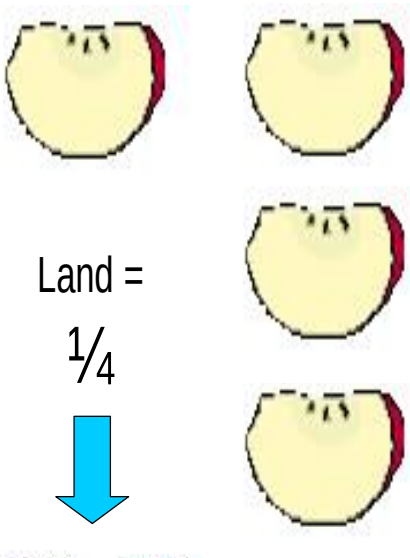
It takes 3.57 bushels of corn to produce 10 gallons of ethanol.

That comes to **21.75 million bushels of corn per day** to supply the US with 10% ethanol blended gasoline!



If the world were an apple...

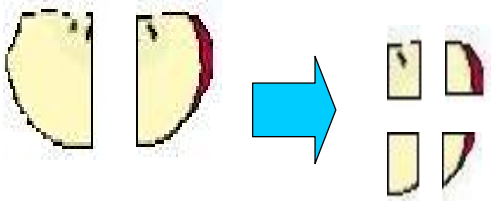




Land = 1/4

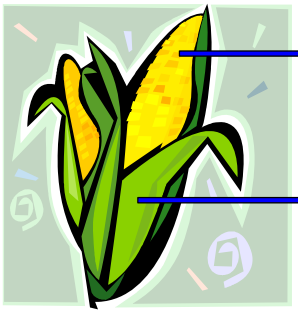
Ocean = 3/4

Humans live on 1/8 of the land, but...



The amount of farmable land can be represented by the skin of 1/32 of the apple!

Making Ethanol from the Corn Plant



Food

Rest of Plant = Lignocellulose

Cellulose	Lignin	Hemicellulose
↓	↓	↓
Glucose	Solid Fuel	Mannose, etc.
↓		↓
Ethanol		Ethanol