

**FACT : CORN IS PROCESSED INTO FUEL FOR CARS. IT IS ALSO PROCESSED INTO PLASTICS AND OTHER INDUSTRIAL PRODUCTS.**

- LESSON 1:** The “Corn for Energy” Campaign (Language Arts, Music, Dance, Art)\*
- LESSON 2:** The State of Ethanol Use (Math)\*
- LESSON 3:** It’s Up to People (History, Social Studies, Current Events)\*
- LESSON 4:** Corn that Bounces & Stretches (Science)\*

*\* All Lesson Plans are adaptable for ALL ages!*

**HUGH BUYS A CAR**

*August 1941*

Hugh had learned to drive a car when he was 8 years old. The field of wheat by his house had been harvested, leaving a wide-open space for driving practice. He had climbed into his dad’s Model T, his feet barely reaching the three pedals, grabbed the steering wheel, revved the engine, and lurched forward. Oh yes, at age 8 he’d felt the power.

Now he was 16 and on his way to owning some of that power. He was buying a car; the most perfect car in the world. He was on his way to owning a 1930 Ford Model A!

He and his dad had seen it the day before. They’d driven to town to buy feed for the chickens, and had just happened to pass the yard where it was sitting. As soon as he’d seen it he knew it was the car for him! He knew he’d look good sitting behind that wheel.

It cost \$350, but he could earn that money working for neighbors. If it took a couple years to pay off, it would still be worth it. His dad’s old Model T had cost less than that when it was new, but cars were getting more expensive every day. He couldn’t wait.

Today was the day he’d dreamed of for years.

First he needed to stop at the courthouse. His parents wanted everything to be legal, which meant he needed to start with a driver’s license. The clerk gave him a form to sign, then typed up a card and asked for his signature. She didn’t ask if he’d taken driving lessons. She didn’t ask if he knew how to drive. She just wanted to make sure she had his name and address correct. He paid a quarter and left, his license secure in his pocket.

The next stop was for the Model A. Oh, it was handsome! Black, with four doors, all opening toward the middle. A gas tank that was filled right in front of the windshield. A spare tire stored near the right front tire. Running boards. Bench seats. A visor over the windshield. It was the most incredible car he’d ever seen.

It was flawless. It was matchless. It was his!



He climbed in, then drove home into the setting sun, whistling “Take Me Out to the Ballgame.” He needed to show his friends. He couldn’t wait to show his friends.

But first he had to do chores.

In the barn, his dad had the radio on. It was the Carter Family Country Music Show. Hugh was shoveling corn into the feed troughs when he heard the radio announcer say something about Henry Ford. He stopped, and turned it up. He didn’t want to miss a word. It might be something about the Model A, his kind of car!

The newscaster read, “Today, August 14, 1941, at the 15<sup>th</sup> Annual Dearborn Michigan Homecoming Day Celebration, Henry Ford unveiled his newest invention, the “vegetable car!”

Hugh hooted with laughter.

“No folks, this was no joke. Mr. Ford proudly presented a cream-colored car whose body was 70 percent composed of fibers from straw, hemp, flax, and other plant materials, the other 30 percent composed of soymeal and liquid bioresin. Mr. Ford demonstrated the strength of the car body to gathered reporters by swinging an axe into the trunk. It bounced off.”

Hugh couldn’t believe it!

“The rubber tires were made from goldenrods by Ford’s close friend, Thomas Edison. The gas tank contained a blend: about 85 percent gasoline and 15 percent corn-derived ethanol. Mr. Ford hopes this is the perfect vehicle for driving the American farmer out of a 20-year economic depression.”

Hugh leaped in the air! He was thunderstruck by the idea of a vehicle made from plant materials that ran on fuel made from corn.

Corn was a crop he knew how to grow! It meant HE could help provide the world with the materials and fuel that would build great economies!

Henry Ford believed in farmers like him and his dad! Ford could see how important agriculture was! He could see it was a good thing for a country to be able to grow its own raw products, especially raw products for something as important as automobiles! He was the greatest inventor of all time.

Oh, what a day! To think, that just that day, at age 16, he’d had the sense to buy a Ford car!

He could hardly wait to see his friends...

*More than 50 years later, Ford’s vision for biologically based cars is moving closer to reality. Over 20,000 flexible-fueled vehicles, capable of running on more than 85 percent ethanol made from corn, are on the road in the U.S. Corn is also being used to make antifreeze, windshield washer fluid, interior plastics, fabrics and more.*



## LESSON 1: THE “CORN FOR ENERGY!” CAMPAIGN

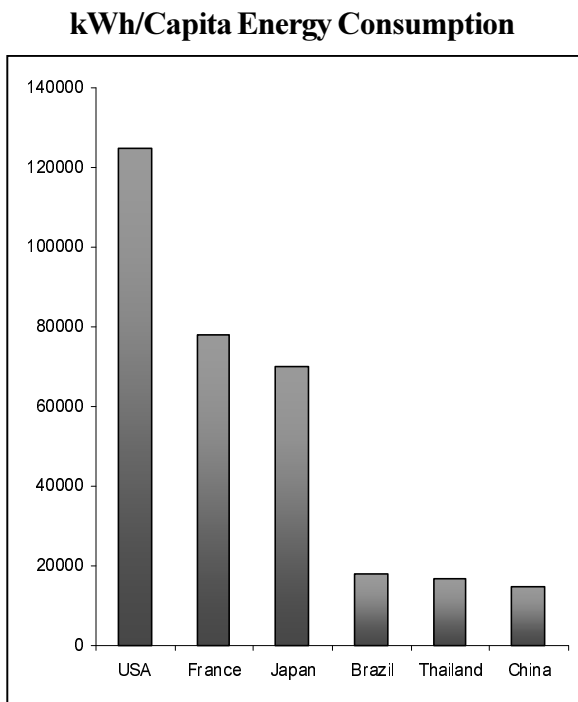
- SUBJECT:** Language Arts, Music, Dance, Art
- OBJECTIVE:** Students will develop a “Corn For Energy” campaign and, in the process, learn many of the benefits of using corn as a biological, renewable source of energy.
- MEASUREMENT:** Students will be able to list the five reasons it is good to use corn for energy. — It is a renewable resource. It is healthier and cleaner for the environment. It is good for national security. It is good for the economy. It is efficient.

### BACKGROUND FOR TEACHERS:

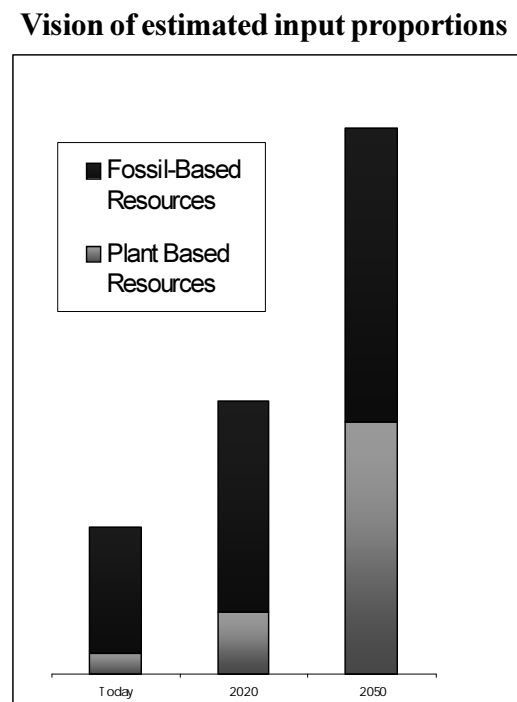
In the United States we take energy for granted. From electricity and heat for our homes, to fuel for our cars, our society is dependent on it.

We currently rely on fossil fuels for the majority of our energy needs—harvesting energy that was once captured by plants then trapped in fossilized layers. We know that fossil fuels are a non-renewable resource, but we do not know how long they will last.

Graph 1 illustrates rates of energy consumption in our country as compared to many other countries. We do not know what will happen to existing reserves when developing countries begin to increase their energy consumption.



**Graph 1**



**Graph 2**



It is extremely important that new sources of energy receive support today, and that they be continually improved. New technologies take time to develop. The petroleum and petrochemical industries have become much more efficient over the last 50 years, after billions of dollars have been spent in research and government subsidies.

The same is possible for energy sources that are renewable and safer for the environment. For example, technology has already reduced the cost of ethanol production from corn by over 50 percent in just the last 10 years. Continued support for research and utilization is an important key to long-term energy stability.

Several government agencies, including the U.S. Department of Energy, many private industries, and several farmer organizations have agreed on a vision, called VISION 2020, that seeks to enhance U.S. economic security through renewable crop-based resources of energy. Their vision for supplementing U. S. energy needs in 21<sup>st</sup> century is illustrated in Graph 2. The complete report is available at [www.ncga.com](http://www.ncga.com).

### STUDENT ACTIVITIES:

1. Ask students to read the story Hugh Buys a Car, emphasizing the radio announcer's description of the "vegetable" car, and Hugh's responses. (For example: "HE knew how to grow corn" and "could help provide the world with the materials and fuel that would build great economies..." and "...it was a good thing for a country to be able to grow its own raw products...")
2. Provide the following "Fact List" about corn as an energy source. Younger students can learn the five key points. Older students will want the complete set of facts! (Example 1)
3. Explain that a campaign is a "group of activities focused on a special purpose." Discuss several kinds of campaigns. (For example: a political campaign, sales campaign, or advertising campaign).
4. Discuss methods of conducting a campaign such as
  - interviews on TV, radio, newspaper, magazines
  - ads on TV, radio, newspaper, magazines
  - bumper stickers
  - educational programs
  - letters
  - phone calls
  - personal visits
  - testimonials
5. Discuss the importance of keeping a campaign message simple and very focused. Ask students if they can explain why this is important (For example: people are busy, there are too many other messages to sort through, you don't want anyone to be confused, it needs to be simple enough to remember, etc.).



6. Ask students to list examples of campaign (or advertising) slogans they think have been effective.
7. Discuss how to measure the success of a particular campaign. (For example: people buy the product, elect the candidate, change their habits, etc.)
8. Then ask students to complete one or more of the following:
  - Write a slogan that encourages people to use “Corn for Energy!” (For example: “*Corn Power!*” “*Tilling, not drilling!*” “*BioEnergy is Better!*” “*Corn Cleans the Air!*” “*Ethanol is A-Maizing!*”) These slogans can be CORNY!
    - Use this slogan to create bumper stickers or posters.
    - Incorporate this slogan into any of the following projects.
  - Create a radio, magazine, or television ad campaign, using art, music, or movement to convince people to use “Corn For Energy!”
  - Role play—One student can be the “campaigner,” another student the “consumer who needs to be educated or convinced” of the benefits of “Corn For Energy!” They can conduct sale pitches, interviews, telephone polls, etc.
  - Write a poem or song that can be used in a “Corn For Energy!” campaign.
  - Older students can write an educational program for preschool or grade school students that incorporates the “Facts” and uses art, music, speeches, stories, etc. to teach “Corn For Energy!” concepts.
  - Convince a local politician or political action group to take up your cause with a “Corn For Energy!” public campaign.



## **“CORN FOR ENERGY” FACT SHEET**

1. We use energy to heat our homes and power our cars, buses, airplanes, and other kinds of transportation.
2. Plants (like corn) can be converted into BIOENERGY! They can be made into liquid, gaseous or solid fuels.
3. Ethanol is a fuel for cars that can be made from corn.
4. Blending ethanol in gasoline helps stretch the supply of fossil fuels, so that supply will last longer.
  - Blending 10% ethanol with gasoline is called E10. ALL car manufacturers warranty their engines to use E10!
  - Blending 85% ethanol with gasoline is called E85. Cars, vans, and pickups that are designed for E85 are increasingly available. They can operate on conventional gasoline also.

### **USE CORN FOR ENERGY BECAUSE IT IS A RENEWABLE RESOURCE!**

1. Corn is a renewable resource. That means we can grow more if we need more.
2. Fossil fuels are a diminishing resource. That means the world can run out of them. The faster that people use fossil fuels, the faster the world will run out.

### **USE CORN FOR ENERGY BECAUSE IT IS HEALTHIER. IT IS CLEANER FOR THE ENVIRONMENT!**

1. When plants were fossilized billions of years ago (this is where the term fossil fuels comes from), the oxygen was squeezed out and foreign minerals like mercury and sulfur were squeezed in. Those minerals pollute the environment and endanger human health when fossil fuels are used.
2. Gasoline is a complex mixture of hundreds of hydrocarbons that are produced at a petroleum refinery.
3. Ethanol is a simple chemical. It is fermented from corn kernels, like wine is fermented from grapes.
  - To stop ethanol from being used as an alcoholic drink, a petroleum-derived chemical is added to it.
  - Do not confuse “ethanol” with “methanol” which is made from natural gas or coal.
4. If you add oxygen to fuel for cars, it helps the engine burn the fuel more completely. It doesn’t need as much oxygen from the air to burn cleanly.
  - Ethanol is called an “oxygenate” because it contains 35% oxygen by weight.



5. About 100 major cities in the United States suffer from unhealthy levels of carbon monoxide and low-level ozone in the air around the city. Much of this pollution comes from auto exhaust. This pollution can damage your lungs.
  - Ethanol reduces the pollution caused by carbon monoxide exhaust by 17-33%.
  - Ethanol mixed with gasoline helps cities clean their air to meet the standards set in the Clean Air Act Amendments of 1990. In Denver, a law requiring a minimum of 1.5% oxygen content resulted in a 9% reduction of carbon monoxide in one year. The next year, the law required a 2 percent oxygen content, and the carbon monoxide levels in the air were reduced 12%.
  
6. Growing corn can help reduce the “greenhouse effect,” or “global warming.”
  - “Global warming” is the result of certain gasses trapping radiation in the atmosphere. Carbon dioxide (CO<sub>2</sub>) is the most common of these gasses, contributing about 50% of the problem.
  - Petroleum usage accounts for about 40 percent of all U.S. CO<sub>2</sub> emissions.
  - Corn breathes in CO<sub>2</sub>, and removes it from the atmosphere. An acre of corn will use up about 25 metric tons of carbon in the form of CO<sub>2</sub>.
  - Ethanol does not add more carbon to the atmosphere. In fact, since ethanol is made from corn, it actually reduces CO<sub>2</sub> in the air. Therefore, increased use of ethanol will partially offset the global warming effect of burning gasoline.

**USE CORN FOR ENERGY BECAUSE IT IS GOOD FOR OUR NATIONAL SECURITY!**

1. Corn is a resource grown in our own country.
  
2. About 50 percent of the oil used in the United States is imported from other countries. That makes our country dependent on other countries, like those in the Persian Gulf, for our fuel. The United States spends a lot of money for the military to protect those foreign sources of fuel.
  - The U.S. has only 4% of known world oil reserves, but consumes 33% of the total.
  - Foreign oil imports are the largest component of the United States’ trade deficit.
  - If control of the Persian Gulf were lost, oil supplies in the U.S. would run out in 14 years.

**USE CORN FOR ENERGY BECAUSE IT IS GOOD FOR THE ECONOMY!**

1. Each 100 million bushels of corn used to produce ethanol creates 2,250 new jobs.
  
2. Ethanol adds 30 cents to the price a farmer receives for every bushel of corn. This helps the farm economy.

**USE CORN FOR ENERGY BECAUSE IT IS EFFICIENT!**

1. Production of ethanol is energy efficient. It yields over 25% more energy than is used in growing the corn,



harvesting it, and refining it into ethanol.

2. You can get both food and fuel from the same kernel of corn. Only the starch in corn is used to make ethanol. All the vitamins, minerals, protein, and fiber, along with some of the energy, can still be used to feed people and animals.





## LESSON 2: THE STATE OF ETHANOL USE

**SUBJECT:** Math

**OBJECTIVE:** Students will use maps, graphs, and tables to learn about ethanol production and use, on a state by state basis.

**MEASUREMENT:** Students will be aware of ethanol production and use in the United States, particularly in their own state.

### BACKGROUND FOR TEACHERS:

Ethanol production and use is steadily increasing in the United States. In the November 1998 *LIFE* magazine's "100 Best Things About America Now" issue, it was stated that "air friendly ethanol now represents 12 percent of U.S. fuel sales." This lags behind other countries—Brazil can operate nearly half of its cars on pure ethanol—but it IS progress!

### STUDENT ACTIVITIES:

1. Ask students to read Hugh Buys a Car, paying close attention to the paragraph which describes Ford's vegetable car "...the gas tank contained a blend: 85 percent gasoline and 15 percent corn-derived ethanol..."
2. Students can complete the worksheet. (Worksheet 1)



### The State of Ethanol Use

Company	Feedstock	Location	Mil/Gal Per year	Company	Feedstock	Location	Mil/Gal Per Year
A.E. Stanley	corn	Louden, TN	45.0	J.R. Simplot	potato waste	Caldwell, ID Burley, ID	6.0
AGP	corn	Hastings, NE	45.0	Jorton Alcohol	corn	Edinburg, TX	1.1
Agri-Energy, LLC	corn	Luverne, MN	12.0	Kraft, Inc.	cheese whey	Melrose, MN	3.0
Alchem	corn	Grafton, ND	10.5	Kor Ethanol	wheat	White, SD	1.0
Al-Corn	corn	Claremont, MN	15.0	MMI/ETOH	brewery waste	Golden, CO	1.5
Archer Daniels Midland	corn	Cedar Rapids, IA Clinton, IA Walhalla, ND Decatur, IL Peoria, IL	750.0	Midwest Grain Products	corn/wheat starch	Pekin, IL Atchinson, KS	108.0
Broin Enterprises	corn	Scotland, SD	7.0	Minnesota Clean Fuels	waste sucrose	Dundas, MN	1.5
Cargill	corn	Blair, NE Eddyville, IA	100.0	Minnesota Corn Processors	corn	Columbus, NE Marshall, MN	110.0
Central Minnesota	corn	Little Falls, MN	15.0	Minnesota Energy	corn	Buffalo Lake, MN	12.0
Chief Ethanol	corn	Hastings, NE	30.0	Morris Ag Energy	corn	Morris, MN	8.0
Corn Plus	corn	Winnebago, MN	17.5	New Energy Corp.	corn	South Bend, IN	85.0
CVEC	corn	Benson, MN	17.0	Pabst Brewing	brewery waste	Olympia, WA	.7
ESE Alcohol	corn	Leoti, KS	1.1	Parallel Products	food and beverage waste	Rancho Cucamonga, CA Louisville, KY	10.0
Ethanol2000	corn	Bingham Lake, MN	15.0	Pro-Corn	corn	Preston, MN	10.0
Georgia-Pacific Corp.	paper waste	Bellingham, WA	3.5	Reeve Agri-Energy	corn/milo	Garden City, KS	10.0
Golden Cheese Co. of California	cheese whey	Corona, CA	2.8	Vienna Correctional	corn	Vienna, IL	.5
Heartland Corn Products	corn	Winthrop, MN	16.0	Williams Energy Services	corn	Pekin, IL	130.0
Heartland Grain Fuel	corn	Aberdeen, SD	8.0				
High Plains Corp.	milo/corn	York, NE Colwich, KS Portales, NM	68.0	<b>Total U.S. Ethanol Production Capacity</b>			<b>1,677.0</b>



1. How many states produce ethanol? \_\_\_\_\_
  2. Which company produces the most ethanol? \_\_\_\_\_
  3. How many more ethanol plants does South Dakota have than Wisconsin? \_\_\_\_\_
  4. How many ethanol plants are there in the US? \_\_\_\_\_
  5. What can be used to make ethanol? \_\_\_\_\_
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**Extra Credit:**

1. Make a graph of at least 10 ethanol plants showing how many million gallons of ethanol they provide every year.
2. Calculate the percentage of total U.S. ethanol production for every state that produces it.



## LESSON 3: IT’S UP TO PEOPLE

- SUBJECT:** History, Social Studies, Current Events and some Math
- OBJECTIVE:** Students will learn that the choices made by people — including themselves and their families — are the most important factors in determining whether renewable corn products like ethanol or biodegradable plastics will be used.
- MEASUREMENT:** Students realize that they make choices every day, and that all people make choices every day, and those choices can affect the future. Hopefully they will also realize that individuals can make a difference by what they say and do!

### BACKGROUND FOR TEACHERS:

Review the teacher’s background, and the “Corn For Energy!” Fact Sheet found in [Unit 7, Lesson 1](#).

There are four possibilities relating to our current position of reliance on foreign countries for so much of our energy supplies. People have the choice. We can:

- Consume less energy  
    Will this lower our standard of living ?
- Produce more energy  
    Will we explore more environmentally sensitive areas?
- Guarantee imports  
    Will we maintain military superiority?
- Find alternatives  
    Will we commit to renewable energy sources?

Review the teacher’s background in [Unit 7, Lesson 4](#) for information on corn as a source of biodegradable plastics. Again, people have the choice!

The student activities in this lesson focus on energy, but all activities are easily adaptable to the issue of biodegradable plastics.

### STUDENT ACTIVITIES:

1. Ask students to read [Hugh Buys a Car](#), paying close attention to Hugh’s feelings and reactions. He was very excited to have his own car. He was very proud to be a farmer, and was even more proud to think that



farmers would be able to grow the raw materials needed for building and running cars. He was also proud of his country, and wanted it to be strong and self-sufficient.

2. Ask the students what they're proud of, and what is important to them. Ask them if they think individual people can make a difference in the world. Help them think of examples where individuals made a difference by standing up for what they believed, or by helping others. (They can think of historical examples like Gandhi, the Pilgrims, Martin Luther King, or they can think of examples from their own lives and school.)
3. Talk about the ways that people can demonstrate their beliefs. For example, if the class already did the "Corn For Energy!" Campaign, ask them to list some of the ways they could demonstrate their belief in "Corn For Energy!" For example:
  - They can teach their families and friends what they know about using corn for energy.
  - They can choose to spend their money (or encourage their parents to spend their money) on gasoline that is blended with ethanol.
  - They can write letters to their representatives in government asking them to encourage the use of energy from corn and other renewable sources by providing tax benefits and money for research.
  - They can thank the people and companies that are using and/or looking for new sources of energy made from corn and other renewable resources.
  - They can thank farmers for raising crops that can be used to supply energy for the world.
  - They can study and learn more about the subject of renewable energy.
4. Tell students that in this lesson they will learn **WHAT PEOPLE KNOW**, and **HOW PEOPLE FEEL** about renewable energy. Then ask them to complete one or more of the following projects. (They might want to do this in teams of two or more!)
  - Interview the owners, customers or employees of several community gas stations. They could also draw a map of the community showing where all the gas stations are located. Mark which ones sell ethanol. A 10% blend of ethanol and gasoline (E10) would be the most common, but some of them might sell an 85% blend (E85).
  - Develop and conduct a survey of students, teachers, families or community members.

Note: It's very important that students develop this survey on their own! The questions need to reflect **THEIR** concerns and **THEIR** understanding of the issues. These surveys can be very simple or very



complex, depending on the maturity of the students. Surveys with “yes or no” questions are the easiest for tabulating results.

Possible knowledge questions for the survey:

- A fuel for cars can be made from corn.
- Ethanol is healthier for the environment than gasoline.
- It’s possible to make ethanol and food from the same bushel of corn.
- Fossil fuels like gasoline are non-renewable.

Possible attitude questions for the survey:

- This country depends too much on oil from the Persian Gulf.
- The government should encourage development of fuel produced from corn.
- The government is doing as much as it should to reduce air pollution.
- Increased use of ethanol is good for the economy.

- Make a scrapbook of news clippings about energy use in the United States. Highlight all the comments made by people that demonstrate their attitudes and beliefs toward sources of energy (fossil fuels or alternative sources like ethanol) and uses of energy (conservation or wasteful).

5. Students should summarize their results, then decide if there is more THEY can do!



## LESSON 4: CORN THAT BOUNCES AND STRETCHES

**SUBJECT:** Science

**OBJECTIVE:** Students will experiment with different recipes that create different forms of biodegradable plastic made from corn. They will be introduced to polymers, both natural and synthetic, and will gain an understanding of the products which can be made from natural polymers like cornstarch.

**MEASUREMENT:** Students will know that many of the plastic materials they encounter in their everyday lives can be made from cornstarch, and that they would then be more biodegradable.

### BACKGROUND FOR TEACHERS:

Plastics are a major problem in our rapidly filling landfills. Plastics made from petroleum do not decompose quickly. New plastics are being developed that are made from cornstarch—a plastic bag containing 10 percent cornstarch will degrade 10-20 times faster than other plastic bags. Other benefits of biodegradable plastic products include:

- Plastic bottles can be made stronger and lighter when made from 15 percent cornstarch.
- Biodegradable plastics are not expensive.
- Biodegradable plastics can be composted and used as a carbon-rich soil supplement.

It is possible to make plastics from starch because starch is a polymer, a molecule of many individual pieces (monomers) all hooked together. A polymer might be demonstrated as a string of beads or paper clips — individual pieces joined together into one long chain. Polymers behave in interesting ways because of their long chain structure.

Some polymers are natural, and some are synthetic (made by people). Many of the natural polymers (protein, starch, cellulose) have names without “poly” because they were named long before people knew about their repeating nature. Their chemical structures are more complex than synthetic polymers due to the complex metabolic functions the natural polymers play in living organisms.

The following are some examples of synthetic polymers and some of their applications:

- Polyethylene: milk jugs, toys, oil containers, squeeze bottles, plastic bags, shrink wrap
- Polyvinyl Chloride: food wrap, vegetable oil bottles, blister packaging, pipes
- Polystyrene: Styrofoam™ cups, packaging, housewares, toys



**STUDENT ACTIVITIES:**

1. Ask students to read the story Hugh Buys a Car, then discuss the concept of creating a “vegetable” car from products made from plant-based industrial products.
2. Ask students to list the “plastic” components of a car. Then ask if they think it’s possible to make such plastics from corn.
3. Introduce students to the concept of polymers by having them create chains from 6-10 paper clips, beads, or rubber bands. Polymers are long chains of individual molecules. Explain that polymers can be made by man (synthetically) but the chemicals used are often petroleum-based and do not decompose easily. This is in contrast to the natural polymers, like those found in cornstarch. These natural polymers are biodegradable and can be used in combination with, or in substitution for, synthetic polymers.
4. Ask students to study the list of familiar things made from polymers and circle those that they consider plastic. (Plastics are defined as “synthetic or natural materials that may be shaped or molded when soft and then hardened.”) (Worksheet 1)
5. Then break students into teams, letting each team make a different kind of “plastic” from cornstarch using the recipes that follow. (For more information on cornstarch see Unit 9, Lesson 3). (Worksheet 2)
6. Point out that these products are very safe and are “biodegradables,” even dissolving in water.





## RECIPES FOR CORN THAT BOUNCE AND STRETCH!

### Recipe One: “Oobleck”

1. Place 4 teaspoons of cornstarch in a shallow dish.
2. Add 2 teaspoons of water.
3. Stir slowly, then stir quickly, then slowly, to observe the behavior of this product.

Teacher’s note: This recipe results in a material that acts like a solid if it is stirred quickly, and like a liquid if stirred slowly. This is because amylopectin, — the polymer found in cornstarch — is a branched polymer, with chains branching off each other, not a single straight line like the chain of beads. When stirring quickly the molecules cannot rearrange themselves quickly enough to let the spoon go through easily. The branched nature of the polymer slows down the rearrangement. Think of this analogy: It’s not too difficult to walk or run through a crowded hallway. But if all the people in the hallway are holding their arms straight out, it will be much more difficult to run than to walk.

The ratio of water to starch is critical. If there is too much water, the starch will always flow easily, but if there is not enough water, the mixture will never flow easily.

### Recipe Two: “Homemade Plastic”

1. Place 2 tablespoons of cornstarch in a re-sealable plastic bag.
2. Add 2 tablespoons of water.
3. Add 4-5 drops of corn or other vegetable oil.
4. For additional effect you may add 2-3 drops of food coloring.
5. Zip the bag closed and knead the bag for several minutes to mix.
6. Unzip a small opening in the top (to vent) and place in a microwave oven on high for 30-40 seconds.
7. Remove the bag and open as soon as it is cool to the touch.
8. Roll into a ball, and enjoy...

### Recipe Three: “Goop for a Group”

Combine:

- 1 ½ cups cornstarch
- 2 cups baking soda (1 lb.)
- 1 ¼ cups water

Mix well. Do not cook! Add tempera or food coloring to water if color is desired.

Teacher’s note: Watch the fascination on student’s faces as they watch the ball they have just made become a glob oozing through their fingers! (See the explanation for this conversion from solid to liquid under “Oobleck.”)



## POLYMERS

Here is a list of familiar things that are made of polymers. Circle the ones you consider “plastic.” How many do you think could be made using cornstarch?

**Teflon™**

**Carpet**

**Gum**

**Styrofoam™ Cups**

**Telephone**

**Jell-O™**

**Sandwich Bag**

**Disposable Diapers**

**Milk Jug**

**Calculator Keys**

**Laundry Basket**

**Garbage Bags**

**Tupperware™**

**Basketball**

**Food Wrap**

**Toothbrush**

**Shower Curtain**

**Rain Coat**

**Silly Putty™**

**Squeeze bottles**

