



Biofuels

Cars and trucks usually run on gasoline or diesel that is made from nonrenewable petroleum. But **biofuels** can be used instead of or in combination with gasoline or diesel to make vehicles run. Biofuels are made from renewable resources such as corn, canola, soybeans or even grasses and wood chips. Biofuel can be used in everything from cars to trucks, lawn mowers to boat motors, motorcycles to snowmobiles! Let's learn more about biofuels.



David Haasser, NDSU



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What is biofuel?

"**Bio**" is from a Greek word meaning living things.

"**Fuel**" is a substance that provides heat or energy.

That means **biofuel** is a substance made from living things that can provide heat or energy.

Circle the renewable resources that biofuel can be made from.

- | | | |
|-----------|-------------|------------|
| Soybeans | Coal | Straw |
| Petroleum | Rocks | Corn |
| Grass | Corn Stalks | Water |
| Canola | Gold | Vegetables |

Biodiesel

Biodiesel is a renewable fuel made from oilseeds, such as soybeans and canola, as well as waste fats left over from cooking, such as french fry grease. Vehicles using biodiesel emit fewer harmful toxins into the air than those burning petroleum diesel.

Ethanol

Ethanol is a renewable fuel made from carbohydrates found in agricultural crops, such as corn. Using ethanol in engines keeps our air healthier to breathe and our environment cleaner, and conserves nonrenewable resources.

Crops for Fuels

Corn is an annual plant that grows 7 to 10 feet tall. A tassel grows at the top of each stalk and contains hundreds of small flowers that produce pollen. Long, sword-like leaves grow out from the stalk. Ears of corn grow where the leaves join the stalks. Leaves called husks protect each ear.

Canola grows 3 to 6 feet tall and blooms with bright yellow flowers in early summer. The flowers produce seed pods about 2 inches long. Each pod turns brown or tan as it ripens and contains 20 or more tiny round black or brownish-yellow seeds.

Soybeans grow in pods on the plants. Each plant may have 60 to 80 pods, and two to four pea-sized beans grow in each pod. The plant's stems, leaves and pods are covered with short, fine hairs. The soybean plant is called a legume because its roots have nodules (small, rounded bumps) that give nutrients back to the soil by collecting nitrogen from the air and releasing it back into the soil.

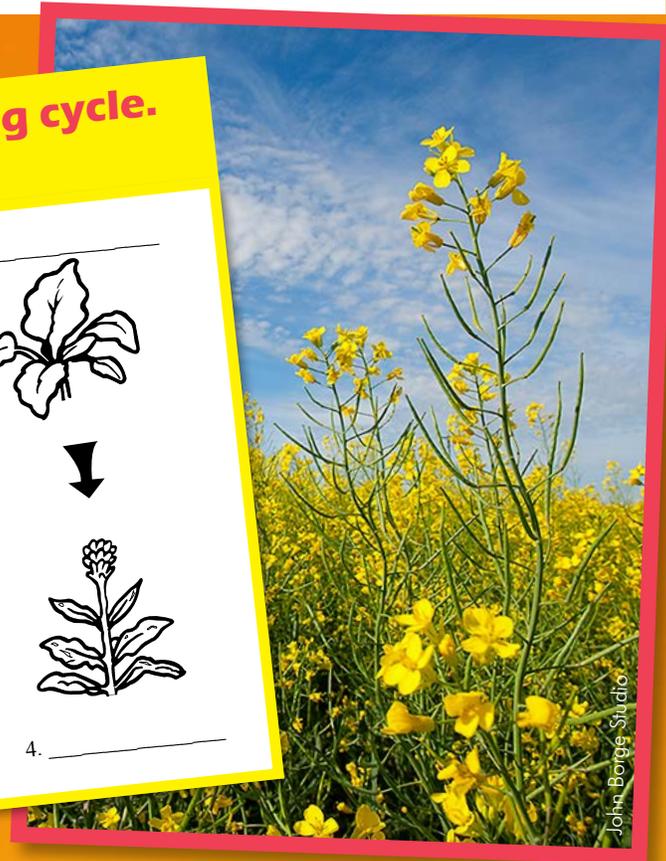
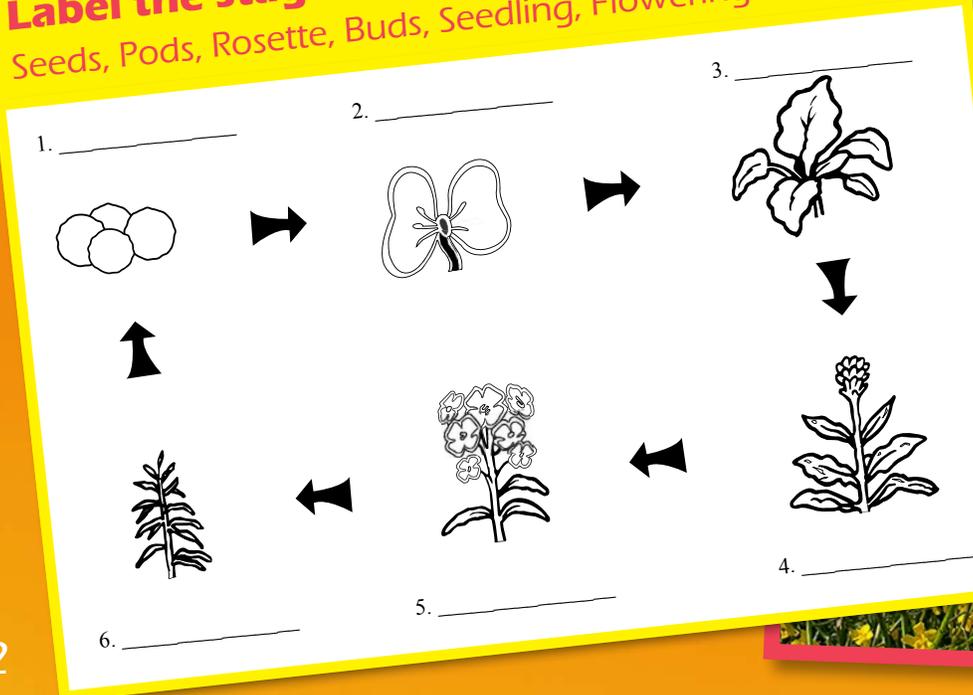
Identify these three North Dakota crops used to make biofuel.



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Label the stages of canola's growing cycle.
Seeds, Pods, Rosette, Buds, Seedling, Flowering



John Borge Studio

Biofuels on the Road

Vehicles that can run on up to 85% ethanol are called flexible-fuel vehicles (FFVs). There are now 121,000 FFVs in North Dakota. FFVs look like other cars and trucks, so you may pass an FFV and not even know it.

All vehicles that run on diesel can use biodiesel. Biodiesel blends up to 20% can be used in any diesel engine with no changes to the engine or fuel system.



David Haasser, NDSU

How Ethanol is Made

Making ethanol takes many steps. Think about production, processing, distribution and consumption to number these steps 1 to 12 in the order in which they happen.

- ___ The trucker hauls the ethanol to gas stations across the region.
- ___ The farmer harvests the corn.
- ___ Your mom and dad fill up their flexible-fuel vehicle with E85 at your local gas station.
- ___ Enzymes are added to the mash to convert it into a sugar.
- ___ The farmer buys corn seed from the elevator.
- ___ After fermentation, the mixture is put through distillation columns, where the ethanol is separated out.
- ___ Water is added to the flour to form a mash.
- ___ The farmer plants the seed.
- ___ The mash is put into a high-temperature cooker to help convert starches to sugars.
- ___ The mash is taken out of the cooker and transferred into a fermenter, where it stays for 40 to 50 hours.
- ___ The farmer hauls the corn to the ethanol plant.
- ___ The corn is ground into flour.



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Around the World

The United States uses more than 19 million barrels of oil each day. The U.S. does not produce that much oil, so we have to import about 25 percent of the oil we use from foreign countries such as **Canada, Mexico, Saudi Arabia, Nigeria, Venezuela, Algeria, Iraq, Colombia, Ecuador and Brazil.**

Identify on the world map the top 10 countries listed above from which the U.S. imports oil.



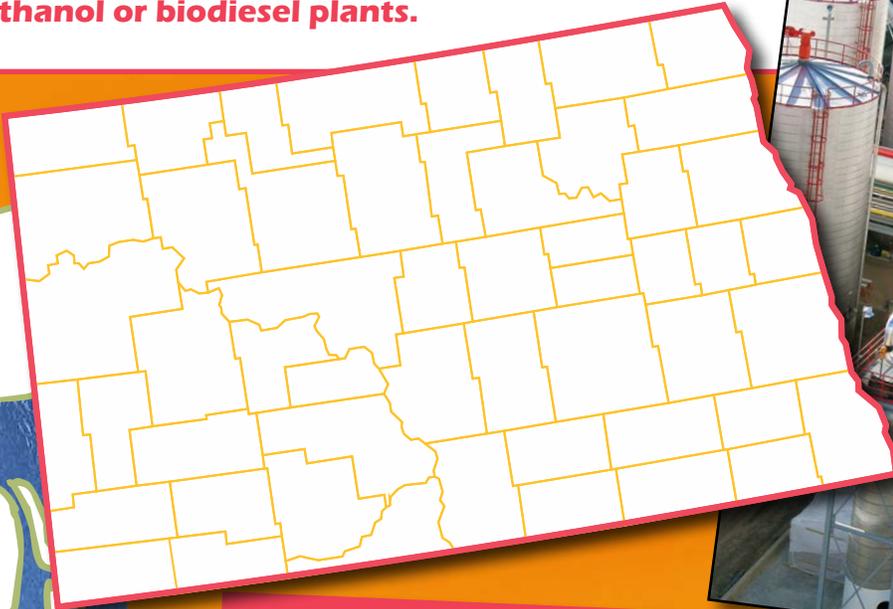
Fast Fact:

The U.S. produced almost 15 billion gallons of ethanol and nearly 1.3 billion gallons of biodiesel in 2015.

Biofuels in North Dakota

Five ethanol plants are operating in North Dakota: Hankinson Renewable Energy in Hankinson, Blue Flint Ethanol in Underwood, Red Trail Energy in Richardton, Tharaldson Ethanol in Casselton and Dakota Spirit Ag Energy in Spiritwood. ADM has a biodiesel plant at Velsa.

On the North Dakota map, identify the six towns that have ethanol or biodiesel plants.



Biodiesel Eco-Rap

This rhyme is so fresh it's green and still growing.
And like a rolling river, the beat keeps on flowing.
But the Earth is fragile and that's a fact.
We've been taking from nature, now it's time to give back.
We've done lots of harm, just by spinning our wheels,
Polluting planet Earth with all these automobiles.
So when I bought my last car, I said I wouldn't buy another
Until they made an engine that ran on apple butter.
But I couldn't find an apple butter car, it's true,
So I got a car that runs on used french fry goo!
It's so great that everybody loves just the taste
But there's a bunch of old fryer grease going to waste.
The diesel engine was designed with peanut oil in mind,
But it could run on almost any oil you could find.
Corn, soy, chicken fat, canola oil or grease —
Farmers could grow their own fuel, not just carrots and peas.
We need to stop burning toxic fuel to make power.
I'd rather get my fuel from a sunflower!
I've got that veggie fuel burning, now I'm rolling with ease.
Is that the scent of french fries I'm smelling on the breeze?

~ Linda K. Hempel

Career Corner

Katelyn Blackwelder

Communications Director
North Dakota Corn Council

As communications coordinator for the North Dakota Corn Council, Katelyn Blackwelder teaches others about ethanol and its benefits.

"The Corn Council carries out research, promotion and education about corn and corn products, like ethanol," Katelyn said. "When farmers sell their corn at an elevator or ethanol plant, a very small portion of the value of each bushel is allocated to the Corn Council. The farmers on the council's board decide how to use these funds for research, education and promotion. These investments build more awareness of corn and ethanol and how it can be used, which ultimately creates a larger market for corn to be sold."

Katelyn says her job with the Corn Council consists of anything and everything relating to promotion and education about corn and corn products, including ethanol.

"Some ways I educate and promote corn and ethanol include social media, events like Ag in the Classroom for students, or events to promote how farmers raise crops in North Dakota," she said. "For example, I've worked with fuel stations to offer discounts on ethanol to encourage consumers to fuel their vehicles with ethanol rather than gasoline. Ethanol and other biofuels are less harmful to the environment than gasoline, are often less expensive and are created from local crops."

Katelyn says helping on her family's dairy and crop farm prepared her most for her career.

"Since I care so much about agriculture and farmers, it's natural for me to bring that passion into a career of promotion and education of ag," she said. "My education at NDSU in agricultural communications and public relations taught me how to better reach out and communicate to others, no matter what form of communication channel: social media, web, print or radio. Internships in the agriculture and communication fields gave me firsthand experience and skills to be better prepared for this type of job and introduced me to other people in similar careers and the ag industry."

Katelyn's main advice for students is to follow your interests and what you're passionate about.

"Since I have a passion for the ag industry and the type of work I do, I enjoy my job and strive to improve in any way that I can," she said. "I love being able to promote and tell others about farmers and agriculture and the hard work they do to create food, feed, fiber and fuel for us!"



North Dakota Corn Council



North Dakota Corn Council



North Dakota Corn Council

Math Challenges

1. Sally filled her car with 12 gallons of E85 gas for \$1.80 per gallon. How much did she pay for all 12 gallons of E85 gas? _____
2. Sally's brother filled his car with 12 gallons of unleaded gas for \$2.09 per gallon. How much did he pay for all 12 gallons of gas? _____
3. How much more did Sally's brother pay than Sally paid for E85 gas? _____
4. Sally's car gets 20 miles per gallon with E85 gas and Sally's brother gets 25 miles per gallon. How many more miles can Sally's brother drive on 12 gallons of unleaded gas than Sally can on E85? _____
5. A corn kernel is made up mostly of starch. If each kernel is 9% protein, 4% oil, 2% ash (minerals) and 9% fiber, what percentage is starch? _____
6. If a farmer is paid \$3 per bushel for corn and \$9 per bushel for soybeans, how much more per bushel will he or she get paid for soybeans? _____
7. If regular diesel weighs 7.1 pounds per gallon and biodiesel weighs 7.35 pounds per gallon, how much more per gallon does biodiesel weigh than regular diesel? _____
8. If 1 bushel of soybeans makes 1.5 gallons of biodiesel, how many gallons of biodiesel will 5 bushels make? _____
9. If 1 bushel of canola makes 2.8 gallons of biodiesel, how many gallons of biodiesel will 5 bushels make? _____



Fuel of the Future

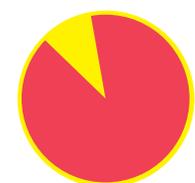
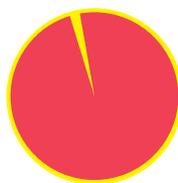
Henry T. Ford made the first car to run on a mixture of gasoline and ethanol in 1908. He called it the fuel of the future. Today all cars are designed to run on a 10% ethanol blend called E10, and most gas sold is E10. Many models can use a fuel called E85 that is 85% ethanol.

Biodiesel also comes in different forms. B2 is 2% biodiesel blended with 98% regular diesel, and B20 is 20% biodiesel blended with 80% regular diesel. What do you think B100 is?

Did You Know?

One acre of corn (the size of one football field) can produce enough ethanol to run a car for about 72,000 miles on E10 unleaded. That is like driving from Fargo, North Dakota, to Dallas, Texas, and back 33 times!

Identify the E10, E85, B2 and B20 blends. The yellow part of each pie chart represents the ethanol and biodiesel portions, and the red part represents the petroleum-based portion.



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