

FROM CORN TO PLASTIC

LESSON OBJECTIVE

By the end of the lesson, students will be able to define the economic concept of scarcity and explain how scarcity and environmental concerns can lead to marketplace innovation. Students will also be able to explain how markets are affected by supply and demand.

VIDEO SYNOPSIS

Students will visit Earth First PLA, a research and development company in Columbus, Ohio. They will learn about developments in the field of corn-based plastics and what this means for the economy and environment.

TEACHER BACKGROUND

Each day, Americans consume over twenty million barrels of oil. The United States as a whole is the world's top consumer of the global petroleum supply. Petroleum—a nonrenewable resource—is used to make the gasoline that powers consumer and commercial vehicles. Because United States producers do not make enough oil in the United States to meet demand, a supply must be imported from countries such as Canada, Mexico, Saudi Arabia, and Venezuela.

Petroleum is also used to manufacture consumer goods, including plastics. Because plastics are a petroleum-based product, they are not biodegradable. Each year the average American consumer produces about 1500 pounds of waste, much of which will be around for hundreds of years to come. According to the Environmental Protection Agency, plastics account for approximately 15 to 20 percent of all waste in landfills today.

Some Ohioans are researching ways to help reduce national usage of foreign petroleum and help increase usage of environmentally-friendly products and energy sources. This research is leading to marketplace innovations. For example, renewable agricultural products such as corn are now being used to produce renewable sources of fuel. Not only is corn being used for fuels such as E-85, but also for corn-based polymers. These plastics deteriorate within weeks of being discarded. A shift to corn-based plastics has many potential benefits for Ohioans. Corn-based plastics could reduce our overall need for petroleum, create new industries and jobs, and increase demand for local crops such as corn while helping reduce landfill waste worldwide.

VOCABULARY

Petroleum
Bio-plastic
Biodegradable

Innovation
Factors of Production
Scarcity

Natural Resource
Renewable Resource



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OHIO ACADEMIC CONTENT STANDARDS

GRADE 9 SCARCITY AND RESOURCE ALLOCATION

1. Explain the effects of shortages, surpluses and government-enforced controls on prices.
2. Explain ways that people respond to incentives when allocating their scarce resources in their roles as producers, consumers, savers, workers and investors.

PRODUCTION, DISTRIBUTION, CONSUMPTION

4. Describe the functions of the components that make up an economic system and describe the relationships among them including:
 - A. Business;
 - B. Productive resources;
 - C. Financial institutions;
 - D. Government;
 - E. Consumers.

MARKETS

8. Explain the effects of specialization, interdependence and trade on the United States and other countries.

INSTRUCTIONAL PROCEDURE

BEFORE VIEWING

Complete the following exercise with students to introduce the concept of scarcity

1. Have students list 15 things they want.
 - 5 things less than \$1
 - 5 things less than \$10
 - 5 things less than \$100
 - 5 things less than \$1000
2. Collect these ideas on the board.
 - Point out that you could continue to add to the list forever, and as soon as they had all of the items on the list, they would just want more things.
3. Now assign dollar amounts to each row. Each row of students will have \$1, \$10, \$100, \$1,000 and so on. List the amounts of each row on the board.
 - Explain that these are their limited resources.



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- On a sheet of paper, have students write “Wants are Unlimited.” Next have them write the dollar amounts they were assigned and the statement “Resources are Limited.”
 - Now have students choose as many items from their lists as they can with their money.
- Have students write their list of choices and the statement “Therefore We Have to Make Choices.”
 - Explain that people have only limited amounts of time, energy, and money. People must choose how to use these scarce resources. The reason we must make choices is because of the scarcity of resources.
- Now, based on the information in the teacher background describe how petroleum, a scarce resource, is used to make plastics. Discuss some of the concerns associated with using petroleum based plastics, then ask students to offer examples of what we can do to reduce waste (recycle).
- Next ask students if they knew that corn, a renewable resource, is now being used to make plastics. Show the video *From Corn to Plastic* and instruct students to take notes while watching. Hold a follow-up discussion after viewing then distribute the worksheets and have students complete.

ANSWER KEY

MULTIPLE CHOICE QUESTIONS

- | | | | | |
|------|------|------|------|-------|
| 1. C | 3. B | 5. D | 7. C | 9. D |
| 2. D | 4. A | 6. B | 8. A | 10. D |

VISUAL AND CONSTRUCTED RESPONSE QUESTIONS

- The demand for corn will change. It will increase because the government incentive will motivate more to use corn based plastics.
- The price of high starch corn will go up because the demand will increase before supply can catch up.
- The demand curve will shift to the right reflecting a higher price where supply and demand intersect.

SHORT ANSWER QUESTIONS

- The benefits of bio-plastics include reducing greenhouse gas emissions in the production process, minimizing toxic waste in the environment and promoting rural economic development by using local crops. They can also be biodegradable, helping minimize the amount of waste in landfills. Less waste and damage to the environment will save tax dollars used in clean-up efforts. Healthier environments lead to healthier people so there are potential health care savings.
- Ms. Sobkowicz decision was a moral one as she cites ethical reasons for wanting to investigate alternative energies. One can infer that she is concerned about the environment and that the oil industry conflicted with her personal values.
- Some argue that plastics made from fossil fuels can be biodegradable. Conversely, bio-based plastics, if not disposed of correctly will not decompose quickly. These arguments come from the petrochemical industry. Some concerns are posed by scientists as well.
- The petrochemical industry would not want to see the bio-plastic industry take away any of its customers.



FROM CORN TO PLASTIC

MULTIPLE CHOICE QUESTIONS

Name: _____

Date: _____

Class: _____

READ THE QUESTIONS BELOW AND CIRCLE THE CORRECT ANSWER FOR EACH. (1 POINT)

1) Which of the following is a renewable resource?

- A. petroleum
- B. natural gas
- C. corn
- D. none of the above

2) Petroleum is a scarce resource. The economic concept of scarcity means that

- A. resources are limited.
- B. wants are unlimited.
- C. people must make choices about what wants to fulfill using scarce resources.
- D. all of the above

3) If farmers were to produce only non-food grade corn for making plastic, it might lead to a shortage in food grade corn. A shortage is a time when

- A. there are too many products that no one wants to buy.
- B. there is not enough of a product that people want to buy.
- C. supply and demand meet and set the price and quantity.
- D. all of the above

4) If farmers concentrate on producing more non-food grade corn for making plastics, a surplus may occur. One of the effects of a surplus of something is that:

- A. prices will fall until all of the surplus is gone.
- B. advertising will increase until we buy up all the surplus.
- C. people will rush to buy what they can until the product runs out.
- D. prices will rise until people find an alternative good to buy.

5) If the plastics industry starts using exclusively corn-based plastics, what will probably happen to the price of edible corn?

- A. It will go up, because the demand is higher.
- B. It will go down, because the supply is higher.
- C. It will go down, because the demand is lower.
- D. It will go up, because the supply is lower.

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- 6) Which of the following would not be an economic reason to support the argument for switching to corn-based plastics?
- A. The demand for petroleum to make plastics would go down.
 - B. People would feel good about using biodegradable products.
 - C. The cost of grain would go up, making food more expensive.
 - D. Farmers would see an increase in profits.
- 7) Today, most plastics are derived from petroleum. What would not be a motivation for developing alternatives to petroleum for creating plastics?
- A. a rise in the price of crude oil
 - B. instability of large oil-exporting companies
 - C. a sharp decrease in the price of crude oil
 - D. environmental concerns
- 8) Which of the following would be an economic incentive for manufacturers to use environmentally-friendly products such as PLA or corn based plastics?
- A. tax breaks offered by the government
 - B. satisfaction from helping the environment
 - C. increased prices for corn
 - D. none of the above
- 9) Ohio has a struggling manufacturing-based economy. What would be a potential incentive for the state to invest in scientific research for bio-plastics?
- A. It would create new jobs in the science and research sectors.
 - B. Scientific discoveries could bring about new products that use Ohio-grown crops.
 - C. Innovative products made from bio-plastics could lead to new manufacturing jobs.
 - D. all of the above
- 10) Ohio has plenty of farmland, workers, and the machinery to produce bio-plastics, three of the factors of production necessary to grow a thriving industry. Which factor of production is missing from the above example?
- A. natural resources
 - B. labor
 - C. capital goods
 - D. enterprise

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VISUAL AND CONSTRUCTED RESPONSE QUESTIONS

Name: _____

Date: _____

Class: _____

DIRECTIONS

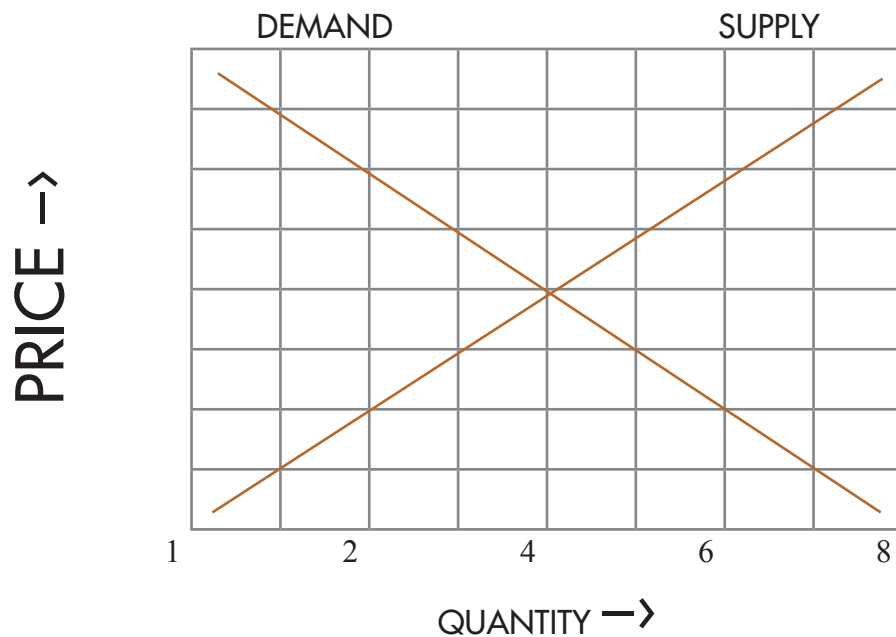
Read the following fictional news headlines. Consider the factors that change supply and demand, and then answer the questions.

“MASSIVE TAX BREAKS TO BE GIVEN TO COMPANIES THAT USE CORN BASED BIO-PLASTICS”

1. What will change in the market for high starch corn, supply or demand? Explain your answer.

2. What effect will the change from answer one have on the price of high starch corn?

3. Based on your answers, illustrate the changes to the supply or demand lines by shifting them to the left or right.



Market for High Starch Corn

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SHORT ANSWER QUESTIONS

Name: _____

Date: _____

Class: _____

DIRECTIONS

Analyze the following excerpts taken from a *New York Times* article. Then answer the questions that follow.

The New Bio-plastics, More Than Just Forks

By Susan Moran. March 7, 2007.

Meg Sobkowicz was on a fast career track in the oil industry...But she jumped off the track. “I knew that working in the oil industry was not in sync with my values,” said Ms. Sobkowicz, 28. “I wanted something with an alternative-energy connection.”

Now, as a doctoral student at the Colorado School of Mines in Golden, Ms. Sobkowicz is one of a growing number of chemists who are developing bio-based plastics that can supplant those made from oil...

Bio-plastics can offer several benefits: reducing greenhouse gas emissions in the production process, minimizing toxic waste in the environment and promoting rural economic development by using local crops. They can also be biodegradable...

Products based on durable biopolymers have begun appearing in the marketplace... The largest commercial producer of bioplastic is NatureWorks, which is owned by the food-processing giant Cargill. The company’s plant, in Blair, Neb., uses corn sugar to produce polylactide plastic packaging materials and its Ingeo-brand fibers...Japanese companies like Nekk Corporation and Unitika are manufacturing cellphones with casings made from bio-plastics.

But representatives of the petrochemical industry point out that plastics made from fossil fuels can be biodegradable, too. And they note that most bio-based plastics, if tossed in a landfill rather than a municipal-scale composting facility, might as well be a tin can or a conventional plastic bottle.

“It’s not just bio-based versus petroleum-based,” said Judith Dunbar, director for environmental issues at the plastics division of the American Chemistry Council, which represents hundreds of plastics manufacturers. “I believe conventional plastics would probably be better than renewables over a full life cycle.”

Even some scientists who are creating bio-plastics caution against overstating their benefits. John Warner, director of the Center for Green Chemistry at the University of Massachusetts at Lowell, said it was unlikely that bio-plastics would offer advantages in every application.

“It’s not about finding the magic material that’ll replace all bad materials,” he said. “That home-run mentality will kill us, because we’d never move forward. But if you promote a replacement material, it’s got to do as good of a job, not just sell itself as a swell biopolymer. And it’s got to be cost effective. We’ll get there.”

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SHORT ANSWER QUESTIONS

Name: _____

Date: _____

Class: _____

Use two to three complete sentences to answer the following questions based on the New York Times article *The New Bio-plastics, More Than Just Forks*.

1. According to the article what are some of the benefits of bio-plastics? How can these benefits have positive economic outcomes?

2. Ms. Sobkowitz left the oil industry to investigate alternative energies. What can you infer about why she made her decision based on the information in the article?

3. What are some of the arguments against bio-plastics? From what industry are these arguments made?

4. For what reason would the petrochemical industry not want to see an increase in the use of bio-plastics?
