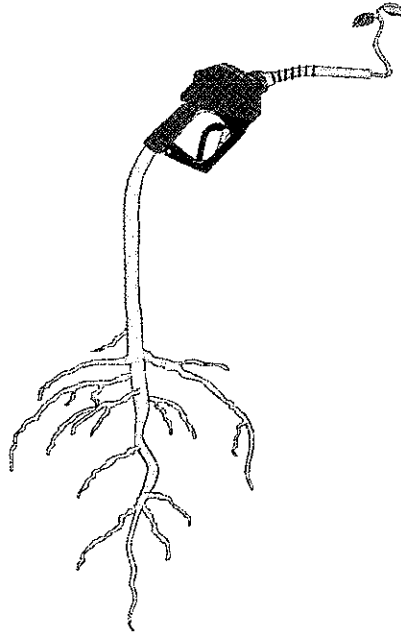


## Part 2 Fueling Change

CropCorp is a new corporation with the mission of developing new **biofuels**.<sup>6</sup> You have been hired as a consultant to manage its newly acquired farm. You must decide which crop will most efficiently transform sunlight into a product that can be used to make a **biofuel**. You want to choose a crop that will make the most efficient use of space and resources (land, fertilizer, money).

The farm you are planning for is located in central New Jersey, where the soil is a mix of sand, clay, and organic material with some stone and gravel. The land is flat with a 2-acre pond and 100 acres of forest that can be used for logging. One acre of land is approximately the size of a football field.

All alternative fuel decisions have environmental and economic costs that must be considered. CropCorp would like you to recommend which crop, corn or **switchgrass**,<sup>7</sup> should be planted on the new farm.



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<sup>6</sup> **biofuels** – any fuels that are obtained from a renewable biological resource

<sup>7</sup> **switchgrass** – native prairie grass that can be grown in abundance in the United States

**Figure 1**  
**Relevant Data Regarding Corn and Switchgrass Crops**

	<b>Corn</b>	<b>Switchgrass</b>
Approximate number of vehicles using fuel type	4 million	0 <b>Note: Technology still being developed</b>
Approximate number of working farms	300,000	100
Minimum temperature	32°F	-42°F
After-harvest regrowth rate	None	Moderate
Other uses for crop	Seed, food, starch, animal feed, sweetener	Decorative landscaping
Precipitation range	20–50 inches/year	12–60 inches/year
Soil textures	Medium	Coarse, fine, and medium
Harvest per acre (average)	3.5 tons/acre	11.5 tons/acre
Fuel per acre (in GJ <sup>8</sup> )	10.15 GJ/acre	26.45 GJ/acre
Part of plant converted to biofuel	Grain	All parts
Cost per acre of production	\$100–150/acre	\$75–100/acre

<sup>8</sup> GJ – one billion joules, which are units of energy used to measure energy content

## PART 2

### Your Task:

- 1) Review the data about corn and switchgrass provided in Figure 1.
- 2) Determine which **ONE** crop you think would be the better crop for the farm, considering all factors provided in Figure 1.
- 3) Write a persuasive argument to the president of the corporation, detailing your decision and justifying your **ONE** crop choice using data from Figure 1. Be sure to include all of the following elements:
  - Which crop you have chosen and why.
  - Cite evidence and data from Figure 1 to support your recommendation.
  - Address potential environmental and economic consequences of your recommendation.

**Please use page 8 in your answer folder for prewriting and planning.**

**Please write your response in paragraph form on page 9 of the answer folder.**

### Fueling Change Scoring Rubric

4 POINTS	3 POINTS	2 POINTS	1 POINT
<ul style="list-style-type: none"> <li>• Selects and thoroughly explains crop choice with no misconceptions.</li> <li>• Uses extensive data from table to support decision.</li> <li>• Shows strong evidence of weighing multiple environmental and economic consequences.</li> <li>• All arguments are strongly based on scientific evidence and/or principles.</li> </ul>	<ul style="list-style-type: none"> <li>• Selects and explains crop choice with no misconceptions.</li> <li>• Uses some data from table to support decision.</li> <li>• Shows some evidence of weighing multiple environmental and economic consequences.</li> <li>• Most arguments are based on scientific evidence and/or principles.</li> </ul>	<ul style="list-style-type: none"> <li>• Selects and explains crop choice with minor misconceptions.</li> <li>• Uses data from table to support decision.</li> <li>• Some arguments are based on scientific evidence and/or principles.</li> </ul>	<ul style="list-style-type: none"> <li>• Selects but does not explain crop choice.</li> <li>• Does not use data from table to support decision.</li> <li>• Few to no arguments are based on scientific evidence and/or principles.</li> </ul>

**Did you remember to:**

- Choose only **ONE** crop for the farm?
- Write a persuasive argument to the president of the corporation?
- Include all the following elements in your argument:
  - Which crop you have chosen and why?
  - Cite evidence and data from Figure 1 to support your recommendation?
  - Address potential environmental and economic consequences of your recommendation?
- Justify all of your work using biological concepts and principles?

## Sample 4-point Score

Dear President of CropCorp,

As you know, a crop is still needed for planting in the newly acquired farmland. I believe the company should plant corn here. Unlike switchgrass, the corn would be much more beneficial to the company. It can be used in many ways. Corn can be useful to the economic part of this as well.

First of all, the fuel made from corn can be used in cars. The technology for cars to use fuel made from switchgrass isn't even finished yet. It is better to make something that people can use. If you invest in switchgrass, the technology could take years to be completed. This would only be a waste of time and money.

Next is that 300,000 farms use corn as a crop. This means that it is successful. Meanwhile, only 100 use switchgrass. There could be problems with the plant or it may not yield enough money to balance out the cost. This makes corn an even better choice.

Another point is that corn has many uses. It can be used for things like seed, animal feed, food, starch, and sweetener. This means not all of the plant would go to waste. It should also make up the balance of cost. Switchgrass, however, can only be used for decorative landscaping. So, it most likely isn't cost-effective in that area.

Last are the downsides to planting corn. According to Figure 1, it's about \$100–\$150 for every acre, while switchgrass is only \$75–\$100. Here, switchgrass is better cost-wise. The grain of corn is the only part that can be used for biofuel as well; however, all of switchgrass can be utilized. This means that you get less biofuel per acre of corn also. Figure 1 shows only 10.15 GJ/acre for corn compared to 26.45 GJ/acre for switchgrass. Only 3.5 tons of corn are harvested, too. It also may not survive a hard frost, as it only survives to about 32°F at the minimum. The company will also have to replant it every year.

In conclusion, corn may have downsides, but it's the upsides that matter. Corn can be used for tons of things and can be cost-effective in the end. It should yield a good crop. If you choose corn, CropCorp will be ahead of its industry.

Sincerely,  
GSH

### 4-point Score

This response received a score point total of 4. The writer selected *corn* as the better crop for the farm because the technology to use corn is already in place, there are more farms harvesting corn than switchgrass, and because of the “many uses” of corn. The data table was effectively used to provide both the pros and cons for selecting corn as the crop of choice. It was noted that over 300,000 farms are presently using “corn as a crop” and that corn is very “cost-effective” because it can be used for seed, food, animal feed, and as a sweetener. The downsides for choosing corn include its high cost per acre, and that “the grain of corn is the only part of the plant that can be used for biofuel.” The writer strongly enhanced the response with scientific evidence and knowledge of science.

## Sample 4-point Score

Dear President,

After a thorough review of the comparison data between the corn and switchgrass, the conclusion has been made that growing switchgrass on the farm would produce the most ideal results; it would also be much easier to maintain and it would be much more efficient than corn. The pros of producing switchgrass most certainly outweigh the cons of growing it. First, a brief overview will enlighten you.

Besides the fact that switchgrass fuel technology has not yet been fully developed, and the fact that it cannot be used for much else besides fuel and decorative landscaping (whereas corn can be utilized for seed, food, starch, animal feed, sweetener), switchgrass proves to be far more advantageous. Of course, the primary objective here is to earn money. There are 300,000 corn farms and only about 100 switchgrass farms. As you can see, switchgrass has much less competition; therefore, a larger profit will be made. Switchgrass is less difficult to take care of, more efficient with fuel and the total quantity in a harvest, and cheaper. It requires any temperature above  $-42^{\circ}\text{F}$ , while corn cannot survive in temperatures below freezing. In southern areas, that could be fine, but the farm's geological location in the colder zone would make it hard to grow corn. It also can grow in coarse, fine, or medium soil, which the farm has a mixture of. Corn can only grow in medium textures. Also, less replanting would have to be done, as it has a moderate after-harvest regrowth rate, as opposed to none with corn.

Switchgrass would be more efficient, so CropCorp's spending would decrease. A penny saved is a penny earned. The harvest per acre is 11.5 tons, and the fuel per acre is 76.45 billion joules; the figures are 3.5 tons per acre and 10.15 joules per acre for corn. As you can see, there is quite a significant difference. Additionally, no part of the plant would go to waste because all of it would be used. Only the grain from corn is used. Finally, the cost is \$25–\$50 cheaper per acre than corn.

Nevertheless, this decision comes with some strings attached to it. There may be potential environmental and economic consequences. First of all, CropCorp would have to log the forest in order to have more space to grow the crop. Deforestation is a significant issue—it destroys habitats of a plethora of different species. An entire ecosystem would be destroyed. Also, if the fields are planted too often, it can result in infertility of the soil, thus inhibiting the planting of more crops and hurting the company financially. A valuable piece of capital would be lost. The final problem that can be foreseen is the failure to develop the proper technology that can utilize switchgrass for fuel. This would result in a disaster—CropCorp would be in possession of a costly farm that would only be good for decorative landscaping. This operation is a high-risk, high-reward experiment. But high risk is something that goes hand-in-hand with the alternative fuel market; therefore, nothing can be done but hoping for the best.

Please consider my proposal with much thought.

Sincerely,  
Your Employee

### 4-point Score

This response received a score point total of 4. The writer selected *switchgrass* as the better crop for the farm because it would be much more efficient and easier to maintain. Using extensive evidence from the table, the writer noted that although switchgrass cannot be used for much else besides fuel, it is still more advantageous than corn. With demand for the product high and fewer farms producing switchgrass, there would be a large profit to be made. The care of switchgrass, the minimum growth temperature, and the fact that it could grow in a variety of soil textures were additional reasons for choosing the crop.

The writer noted the decision of choice comes with some “strings attached.” CropCorp might have to log the forest adjacent to the farm, thus destroying habitats. In addition, repeated plantings could result in soil infertility, which might inhibit future plantings. All of the evidence and arguments were thoroughly explained with no misconceptions. The writer strongly enhanced the response with scientific evidence.

### Sample 3-point Score

Switchgrass is an alternative source of fuel that is inexpensive and plentiful. It is cheaper than corn and provides more fuel. Therefore, it should be the best choice for the farm.

Switchgrass can survive in extremely low temperatures, lowering the costs needed to maintain a certain temperature. Unlike corn, switchgrass can withstand temperatures as low as negative forty-two degrees Fahrenheit. This would decrease the amount of money needed to keep it above a certain temperature, as it would be shocking if the temperature were to drop that low.

Once grown, the switchgrass is bountiful and much of it would be able to be put toward fuel. The only use of switchgrass, other than for potential fuel, is for decorative landscaping, so it will not be scarce. Switchgrass is only seventy-five to a hundred dollars per acre and given there is almost twelve tons of it grown per acre, there is a lot to be grown at such a low price. Switchgrass can be grown in a wide range of soil textures, such as coarse, fine, and medium. It is perfect for the area the new farm is in.

Switchgrass has much fuel potential, making it the ideal crop. You can get about 26.45 billion joules of fuel per acre. With almost twelve tons of it per acre, that's a lot of potential fuel. Every part of the switchgrass can be converted into fuel, leaving no waste.

Obviously, switchgrass is the best choice for the new farm. It is inexpensive and easily maintained. It also can be converted into extremely large amounts of fuel.

#### 3-point Score

This response received a score point total of 3. The writer selected *switchgrass* as the better crop, citing it was cheaper than corn and would provide more fuel. Using some information from the data table, the writer notes that switchgrass can survive at extremely low temperatures, has a low per-acre production cost, and is able to be grown in a wide variety of soil textures. The writer provides some evidence in addressing the economic and environmental issues in choosing switchgrass. The plant has relatively low per-acre fuel cost and every part of the switchgrass plant can be converted into fuel, leaving no waste. Most arguments are based on scientific evidence and supported with sound principles.



## Sample 2-point Score

Corn is the best option for the farm. Although switchgrass is the seemingly better option in terms of survivability, cost, and crop output, there is no functional machine that uses switchgrass as a power source. It seems pointless to invest in a crop which is only useful if used to fuel vehicles that do not exist. The current number of switchgrass farms is needed for biofuel because most of the existing corn farms are used for making corn into food and other products. The fact that only the grain of corn is used is negligible. As corn is a plant, any waste products can be easily recycled into fertilizer for next year's crop.

### 2-point Score

This response received a score point total of 2. The writer selected *corn* and explained, with some minor misconceptions, why the choice was the best option for the farm. Although switchgrass is a “better option in terms of survivability, cost, and crop output, there is no functional machine that uses switchgrass as a power source.” The response uses a limited amount of information from the data table, specifically calling attention to the current number of corn farms and to the parts of the corn plant used in making fuel. Only some of the writer's arguments are based on scientific knowledge.

### Sample 1-point Score

I would choose the corn for now, but when the technology for switchgrass is developed, then the switchgrass will be a better choice.

#### 1-point Score

This response received a score point total of 1, as the writer chose *corn* as the best option for the farm. The response contains a limited explanation for choosing corn, does not use data from the data table to support a decision, and no arguments are based on scientific evidence or principles.

### Sample 1-point Score

I think that corn is the better crop for the farm.

Dear President of the Corporation,

I feel that switchgrass is the better crop for the farm, considering most factors provided. Switchgrass is cheaper than corn per acre of production. Switchgrass also has more of soil textures—not just one.

#### 1-point Score

This response received a score point total of 1 due to the inconsistencies in the writer's response. Corn was initially chosen as the crop of choice, but the body of the response primarily deals with switchgrass. Although a crop was selected, the response lacked an explanation for the choice, had little support from the data table, and contained no arguments that were based on scientific evidence or principles.