ENGLISH LANGUAGE AND COMPOSITION

SECTION II

Total time—2 hours and 15 minutes

3 Questions

Question 1

Suggested reading and writing time—55 minutes

It is suggested that you spend 15 minutes reading the question, analyzing and evaluating the sources, and 40 minutes writing your response.

Note: You may begin writing your response before the reading period is over.

(This question counts as one-third of the total essay section score.)

Vertical farms are indoor agricultural facilities in which plants are grown, often in a hydroponic (soilless) environment, on tall stacks of shelves. Plants are given water, nutrients, and light mostly through automated processes. Advocates say that vertical farms are key to providing food for the future, yielding high-quality produce while making efficient use of land and water. Critics warn about the energy consumption associated with vertical farms' automated processes as well as problems related to cost and nutritional value.

Carefully read the following six sources, including the introductory information for each source. Write an essay that synthesizes material from at least three of the sources and develops your position on the value, if any, of vertical farms to the future of agriculture.

Source A (Severson article)
Source B (Ling and Altland interview)
Source C (table from Kozai and Niu)
Source D (Foley article)
Source E (Benke and Tomkins article)
Source F (graphic from Despommier)

In your response you should do the following:

- Respond to the prompt with a thesis that presents a defensible position.
- Select and use evidence from at least three of the provided sources to support your line of reasoning. Indicate clearly the sources used through direct quotation, paraphrase, or summary. Sources may be cited as Source A, Source B, etc., or by using the description in parentheses.
- Explain how the evidence supports your line of reasoning.
- Use appropriate grammar and punctuation in communicating your argument.

GO ON TO THE NEXT PAGE.

Source A

Severson, Kim. "No Soil. No Growing Seasons. Just Add Water and Technology." *The New York Times*, 6 July 2021, www.nytimes.com/2021/07/06/dining/hydroponic-farming.html.

The following is excerpted from an online article published in a national American newspaper.

[A] high-tech greenhouse so large it could cover 50 football fields glows with the pinks and yellows of 30,600 LED and high-pressure sodium lights.

Inside, without a teaspoon of soil, nearly 3 million pounds of beefsteak tomatoes grow on 45-feet-high vines whose roots are bathed in nutrient-enhanced rainwater. Other vines hold thousands of small, juicy snacking tomatoes with enough tang to impress Martha Stewart,[1] who is on the board of AppHarvest, a start-up that harvested its first crop here in January and plans to open 11 more indoor farms in Appalachia by 2025.

In a much more industrial setting near the Hackensack River in Kearny, N.J., trays filled with sweet baby butterhead lettuce and sorrel that tastes of lemon and green apple are stacked high in a windowless warehouse—what is known as a vertical farm. Bowery, the largest vertical-farming company in the United States, manipulates light, humidity, temperature and other conditions to grow produce, bankrolled by investors like Justin Timberlake, Natalie Portman, and the chefs José Andrés and Tom Colicchio.

"Once I tasted the arugula, I was sold," said Mr. Colicchio, who for years rolled his eyes at people who claimed to grow delicious hydroponic produce. "It was so spicy and so vibrant, it just blew me away."

The two operations are part of a new generation of hydroponic farms that create precise growing conditions using technological advances like machine-learning algorithms, data analytics and proprietary software systems to coax customized flavors and textures from fruits and vegetables. And they can do it almost anywhere.

These farms arrive at a pivotal moment, as swaths of the country wither in the heat and drought of climate change, abetted in part by certain forms of agriculture. The demand for locally grown food has never been stronger, and the pandemic has shown many people that the food supply chain isn't as resilient as they thought. . . .

"We've perfected mother nature indoors through that perfect combination of science and technology married with farming," said Daniel Malechuk, the chief executive of Kalera, a company that sells whole lettuces, with the roots intact, in plastic clamshells for about the same price as other prewashed lettuce. In March, the company opened a 77,000-square-foot facility south of Atlanta that can produce more than 10 million heads of lettuce a year. . . .

Although the nutritional profile of hydroponic produce continues to improve, no one yet knows what kind of long-term health impact fruits and vegetables grown without soil will have. No matter how many nutrients indoor farmers put into the water, critics insist that indoor farms can never match the taste and nutritional value, or provide the environmental advantages, that come from the marriage of sun, a healthy soil microbiome and plant biology found on well-run organic farms.

"What will the health outcomes be in two generations?" Mr. Chapman [Dave Chapman, a Vermont farmer and the executive director of the Real Organic Project] asked. "It's a huge live experiment, and we are the rats."

[1] businesswoman and television presenter whose work focuses on crafts, recipes, and home goods

Source B

Ling, Kai-Shu, and James Altland. Interview by Georgia Jiang. "Vertical Farming—No Longer a Futuristic Concept." *Under the Microscope: Zooming in on Agriculture's Biggest Challenges*, Agricultural Research Service, United States Department of Agriculture, 27 Jan. 2022, www.ars.usda.gov/oc/utm/vertical-farming-no-longer-a-futuristic-concept.

The following is excerpted from an interview with Kai-Shu Ling, a research plant pathologist, and James Altland, a research horticulturalist. The interview is one of the "Under the Microscope" series of monthly interviews published online by the Agricultural Research Service [ARS] of the United States Department of Agriculture [USDA].

UM [Under the Microscope Interviewer]—What are the advantages of vertical farming?

KL [Kai-Shu Ling]: Vertical farming offers many benefits that traditional farming cannot. For example, while the crops produced by traditional farming are limited by geographic region and seasonal changes, vertical farming allows growers to grow regional or seasonal crops indoors year-round. They can grow crops anywhere a greenhouse or controlled environment can be established. As a result, consumers (especially those in urban areas typically far from traditional farmlands) can also have easier access to fresher produce.

We're currently repurposing ship containers to become vertical farming research units. Although vertical farming's high costs can often be discouraging, shipping containers and abandoned warehouses are readily available and relatively inexpensive. Converting them into vertical farming environments not only breathes life back into discarded infrastructure but also puts fresh produce in parking lots and urban centers.

JA [James Altland]: Vertical farming also uses much less land. For some crops, 10 to 20 times the yield can be obtained per acre in vertical farming compared to open-field crops. Other advantages are that vertical farms are in enclosed structures, so not subject to extreme or inclement weather. Vertical farms are being built in deserts, high-population urban areas, and other places that traditional open-field farming is not practical.

UM—What are the limitations to this type of farming? What is ARS doing to overcome these challenges?

JA: The major disadvantage is that you give up access to the Sun, which is [the] most abundant (and free) source of energy on Earth. Growing plants vertically in stacked systems often requires artificial light sources, which can become costly. Vertical farming also requires humidity control through expensive and energy-intensive heating, ventilation, and air conditioning (HVAC) systems. . . .

UM—What crops are best grown through vertical farming? Which crops are better suited for traditional farming?

JA: Currently, lettuce and other leafy greens are the most popular crops for vertical farming. While research is underway to grow all types of crops in vertical farms, the most successful ones today would be those that can be grown hydroponically, have relatively short compact growth forms, and can be harvested in their entirety. For example, lettuce can be harvested in its whole form, as opposed to corn where only the cob is harvested for sale and the rest must be disposed of some other way.

KL: We're currently investigating the vertical farming potential of small fruits (e.g., strawberries) and fruiting vegetables (e.g., tomato, pepper). . . . Cereal and row crops (e.g., corn, rice, wheat and soybeans) are still better

GO ON TO THE NEXT PAGE.

suited for traditional farming. . . .

UM—I understand that vertical farming has launched into space. What are you hoping to accomplish with this effort?

JA: NASA is keenly interested in CEA [controlled environment agriculture] for its use on long-term manned space missions.

KL: Agreed. NASA is a pioneer in research on crop production under controlled environment. NASA continues to improve the technologies for growing vegetables and fruits in space for future Moon and Mars explorations. USDA has a long history of collaboration with NASA on controlled environment agriculture research.

GO ON TO THE NEXT PAGE.

Source C

Kozai, Toyoki, and Genhua Niu. "Role of the Plant Factory with Artificial Lighting (PFAL) in Urban Areas." *Plant Factory: An Indoor Vertical Farming System for Efficient Quality Food Production,* edited by Toyoki Kozai et al., Elsevier, 2016, pp. 7–32.

The following is adapted from a table published in a book on vertical farming.

Classification of Four Types of Plant Production Systems by Their Relative Stability and Controllability, and Other Factors

Stability and Controllability	Open Fields	Greenhouse: Soil Culture	Greenhouse: Hydroponics	Vertical Farms
Natural stability of aerial zone	Very low	Low	Low	Low
Artificial controllability of aerial zone	Very low	Medium	Medium	Very high
Natural stability of root zone	High	High	Low	Low
Artificial controllability of root zone	Low	Low	High	High
Vulnerability of yield and quality	High	Medium	Relatively low	Low
Initial investment per unit land area	Low	Medium	Relatively high	Extremely high
Yield	Low	Medium	Relatively high	Extremely high

Note: "Aerial zone" refers to weather in the "Open Fields" category; "root zone" refers to soil environment.

GO ON TO THE NEXT PAGE.

Source D

Foley, Jonathan. "No, Vertical Farms Won't Feed the World." *GlobalEcoGuy*, 1 Aug. 2018, globalecoguy.org/no-vertical-farms-wont-feed-the-world-5313e3e961c0.

The following is excerpted from an article published online by an environmental scientist and sustainability expert.

[T]here are costs to these [vertical] farms. *Huge* costs.

First, these systems are *really* expensive to build. The shipping container systems developed by [container farming technology company] Freight Farms, for example, cost between $82,000 and $85,000 *per container*—an astonishing sum for a box that just grows greens and herbs. Just one container costs as much as 10 entire acres of prime American farmland—which is a far better investment, both in terms of food production and future economic value. Just remember: farmland has the benefit of generally *appreciating* in value over time, whereas a big metal box is likely to only decrease in value.

Second, food produced this way is *very* expensive. For example, the *Wall Street Journal* reports that mini-lettuces grown by Green Line Growers cost more than *twice* as much as organic lettuce available in most stores. And this is typical for other indoor growers around the country: it's very, very expensive, even compared to organic food. Instead of making food *more* available, especially to poorer families on limited budgets, these indoor crops are only available to the affluent. It might be fine for gourmet lettuce, or fancy greens for expensive restaurants, but regular folks may find it out of reach.

Finally, indoor farms use *a lot* of energy and materials to operate. The container farms from Freight Farms, for example, use about 80 kilowatt-hours of electricity a day to power the lights and pumps. That's nearly 2–3 times as much electricity as a typical (and still very inefficient) American home, or about 8 times the electricity used by an average San Francisco apartment. And on the average American electrical grid, this translates to emitting *44,000 pounds of CO2 per container per year*, from electricity alone, not counting any additional heating costs. This is *vastly* more than the emissions it would take to ship the food from someplace else.

And none of it is necessary.

But, Wait, Can't Indoor Farms Use Renewable Energy?

Proponents of indoor techno-farms often say that they can offset the enormous sums of electricity they use, by powering them with renewable energy—especially solar panels—to make the whole thing carbon neutral.

But just stop and think about this for a second.

These indoor "farms" would use solar panels to harvest naturally occurring sunlight, and convert it into electricity, so that they can power . . . *artificial sunlight*? In other words, they're *trying to use the sun to replace the sun*.

But we don't need to replace the sun. Of all of the things we should worry about in agriculture, the availability of free sunlight is not one of them. Any system that seeks to replace the sun to grow food is probably a bad idea.

Source E

Benke, Kurt, and Bruce Tomkins. "Future Food-Production Systems: Vertical Farming and Controlled-Environment Agriculture." *Sustainability: Science, Practice and Policy*, vol. 13, no. 1, Nov. 2017, pp. 13-26, www.tandfonline.com/doi/full/10.1080/15487733.2017.1394054.

The following is excerpted from a research article in an online interdisciplinary journal that focuses on sustainability-related topics.

The vertical farming model was proposed with the aim of increasing the amount of agricultural land by 'building upwards.' In other words, the effective arable [1] area for crops can be increased by constructing a high-rise building with many levels on the same footprint of land (Despommier 2010; The Economist 2010). One approach is to employ a single tall glasshouse design with many racks of crops stacked vertically. It is an extension of the greenhouse hydroponic farming model and addresses problems relating to the use of soils, such as the requirement for herbicides, pesticides, and fertilizers. . . .

Clean, green, and gourmet (CGG) food

The possibility of CGG food production is easily the most attractive feature of the vertical farming model. This aspect is less price sensitive to affluent consumers in high-demand countries such as China. All-year-round crop production without seasonality, in a climate-controlled environment (including both temperature and humidity), will produce fresh produce virtually on demand. There would be no weather-related crop failures due to drought or flooding if hydroponic and aeroponic technologies are employed.

Using recycled water and nutrients in a closed, indoor, climate-controlled environment adds to food security and can reduce or even completely eliminate the need for pesticides and herbicides. Contamination by pathogens or heavy metals will no longer be an issue as occurs in rural farming. There is scope for marketing the product in this respect. Strict hygienic practices must still be observed to minimize the risk of introduction of pathogens and biological contamination into the growing space. However, in a vertical farming situation, one can closely monitor the crop for signs of pest or disease both manually and automatically using sensing technologies. This mode of cultivation is very well suited to adopting new and emerging robotic technologies as well as remote-sensing procedures. This means that outbreaks are detected early to enable diseased and infested plants to be identified and disposed of appropriately. Any residual contamination can be cleaned up when the crop is harvested using strict hygienic practices.

One possible obstacle to vertical farming is that some consumers may regard the products as 'Frankenfoods,' as discovered by managers of a giant underground farm supplying London's restaurants (Curtis 2016) and another business that supplies between 8% and 12% of the British output of tomatoes, peppers, and cucumbers (Fletcher 2013). For this reason, some enterprises may not publicize growing conditions for fear of alienating consumers and destabilizing sales potential. To minimize this issue, it can be stressed that growing conditions are not different from existing hydroponic facilities with respect to germplasm, [2] nutrition, and other cultural

GO ON TO THE NEXT PAGE.

and production practices. Furthermore, the plants are derived from natural breeding programs with normal nutrients supplied. There is an advantage that plants are grown in a hygienic environment with reduced need for pesticides and are in a closed system so there is no environmental pollution from nitrogen leaching or run-off.

[1] suitable for growing crops

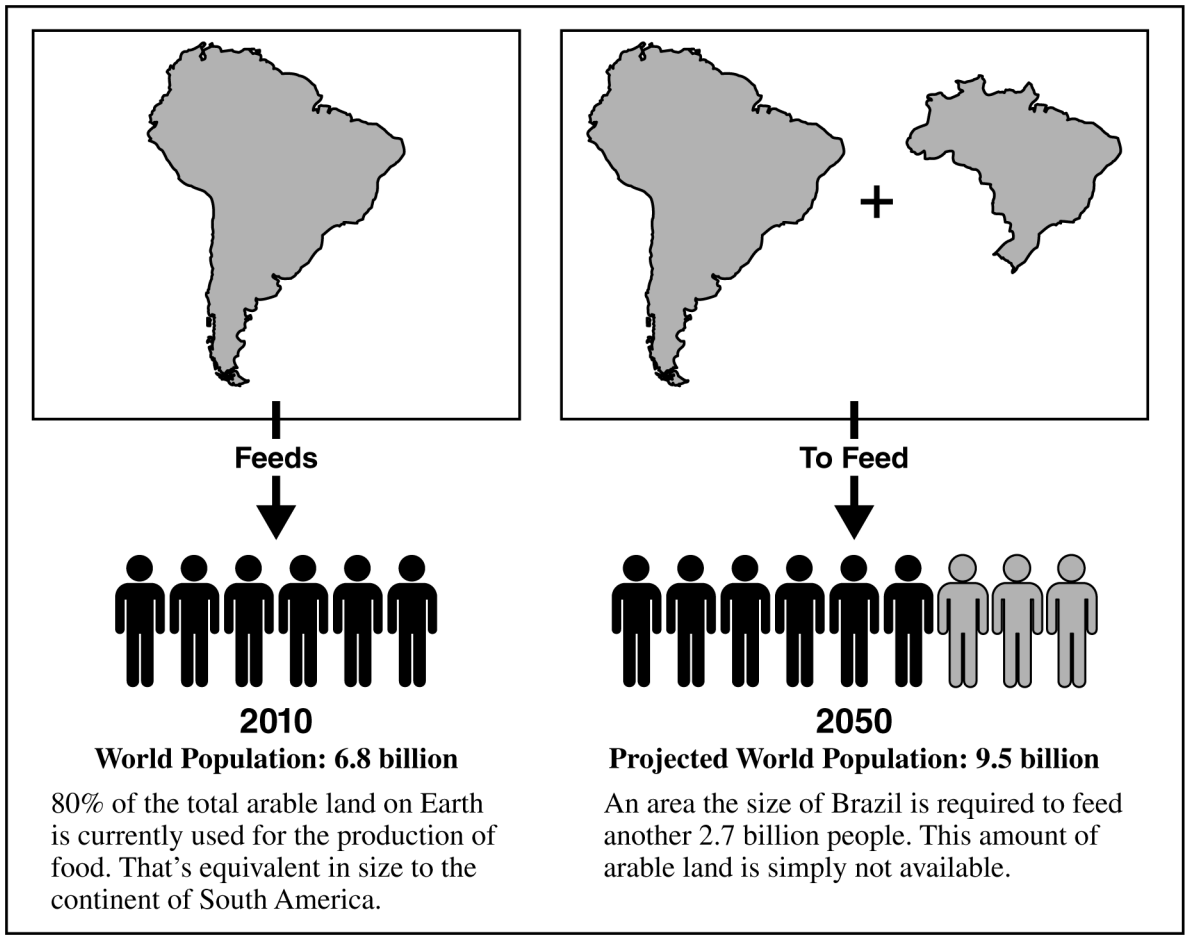
[2] living plant tissue used to generate other plants

GO ON TO THE NEXT PAGE.

Source F

Despommier, Dickson D. *The Vertical Farm: Feeding the World in the 21st Century*. Thomas Dunne / St. Martin's, 2010.

The following is adapted from a graphic published in a book about vertical farming.



Note: Arable land is land that is used or suitable for growing crops.

Begin your response to this question at the top of a new page in the separate Free Response booklet and fill in the appropriate circle at the top of each page to indicate the question number.

GO ON TO THE NEXT PAGE.

Question 2

Suggested time—40 minutes

(This question counts as one-third of the total essay section score.)

On May 21, 2016, the poet Rita Dove delivered a commencement address to graduating students at the University of Virginia at Charlottesville, where she was a professor of English at the time. Dove received a Pulitzer Prize for her poetry and served as the United States poet laureate from 1993 to 1995. She also writes in a variety of genres including fiction and drama. The following is an excerpt from her speech. Read the passage carefully. Write an essay that analyzes the rhetorical choices Dove makes to convey her message about what she wishes for her audience of graduating students.

In your response you should do the following:

- Respond to the prompt with a thesis that analyzes the writer's rhetorical choices.
- Select and use evidence to support your line of reasoning.
- Explain how the evidence supports your line of reasoning.
- Demonstrate an understanding of the rhetorical situation.
- Use appropriate grammar and punctuation in communicating your argument.

I am extremely delighted to be here today, at the very institution where I have been teaching for the past twenty-seven years.

Although I have given commencement speeches before, this one is different; this is personal.

The job of a commencement speaker—I googled it, so it must be true!—is to dispense "life advice." That seems the very opposite of Percy Bysshe Shelley's[1] definition of the poet as "a nightingale who sits in darkness and sings to cheer its own solitude with sweet sounds." So I will not give you advice. The last thing you want to hear is advice—because in order to be effective, advice must be specific—and that, obviously, is impossible in this setting.

So instead of advice, I will give you wishes. Just think of me as a contrary fairy godmother or a wily genie.

I wish you Hunger.

Of course, I don't mean physiological want, but a continued spiritual and intellectual appetite, a hunger to know more, do more, feel more. When I told my graduate poetry writing class that I was giving this speech, I asked them what they wished they had heard at their baccalaureate exercises, and one young woman responded with a list of, as she put it, "some things . . . I wish I could have heard, if I'd had sense enough to listen."

1. Life is short.
2. Don't put yourself in a box.
3. There's a reason certain people, places, books, ideas, etc. make our ears stand up; always follow what attracts you.

And number 4, which to me is the kicker:

4. Passions are hard to come by.

When you entered this university, you wanted to eat the world, and all everyone else wanted you to do was to get good grades. And though your dreams may have been more nebulous[2] then than they are now, they were no less intense. So keep that hunger; nurse it. Stay curious, want it all while it lasts.

I wish you Hard Work.

By that I don't mean back-breaking labor, not the drudgery of the treadmill, but an appreciation for the work that comes before the big show—getting ready, honing your tools. Observation, research, practice—the actress Lupita Nyong'o gives herself homework whenever she has an audition. The classical flautist James Galway says: "You can sight-read better if you know your scales and arpeggios." When my father sat me down for the "You're-going-out-into-the-world" talk, his message was this: Always be 150% prepared! At 150% you'll be ready for anything—even if you're not chosen for a job or position although you're the better qualified candidate. As the first African-American research chemist to break the color barrier in the tire and

GO ON TO THE NEXT PAGE.

Synthesis Essay — 6 points

Vertical farms are indoor agricultural facilities in which plants are grown, often in a hydroponic (soilless) environment, on tall stacks of shelves. Plants are given water, nutrients, and light mostly through automated processes. Advocates say that vertical farms are key to providing food for the future, yielding high-quality produce while making efficient use of land and water. Critics warn about the energy consumption associated with vertical farms' automated processes as well as problems related to cost and nutritional value.

Carefully read the following six sources, including the introductory information for each source. Write an essay that synthesizes material from at least three of the sources and develops your position on the value, if any, of vertical farms to the future of agriculture.

Source A (Severson article)
Source B (Ling and Altland interview)
Source C (table from Kozai and Niu)
Source D (Foley article)
Source E (Benke and Tomkins article)
Source F (graphic from Despommier)

In your response you should do the following:

- Respond to the prompt with a thesis that presents a defensible position.
- Select and use evidence from at least three of the provided sources to support your line of reasoning. Indicate clearly the sources used through direct quotation, paraphrase, or summary. Sources may be cited as Source A, Source B, etc., or by using the description in parentheses.
- Explain how the evidence supports your line of reasoning.
- Use appropriate grammar and punctuation in communicating your argument.

<table>
<tr><th>Reporting Category</th><th colspan="2">Scoring Criteria</th></tr>
<tr><td rowspan="5">Row A
Thesis
(0–1 points)</td><td>0 points
For any of the following:
There is no defensible thesis.
The intended thesis only restates the prompt.
The intended thesis provides a summary of the issue with no apparent or coherent claim.
There is a thesis, but it does not respond to the prompt.</td><td>1 point
Responds to the prompt with a thesis that presents a defensible position.</td></tr>
<tr><td colspan="2">Decision Rules and Scoring Notes</td></tr>
<tr><td>Responses that do not earn this point:
Only restate the prompt.
Do not take a position, or the position is vague or must be inferred.
Equivocate or summarize others’ arguments but not the student’s (e.g., some people say it’s good, some people say it’s bad).
State an obvious fact rather than making a claim that requires a defense.</td><td>Responses that earn this point:
Respond to the prompt by developing a position on the value, if any, of vertical farms to the future of agriculture, rather than restating or rephrasing the prompt. Clearly take a position rather than just stating there are pros/cons.</td></tr>
<tr><td>Examples that do not earn this point:
Restate the prompt
“Proponents of vertical farms argue that they are the key to providing food in the future, while critics warn about the cost and energy consumption of vertical farms.”
Address the topic of the prompt but do not take a position
“Vertical farms, or indoor farms where food is grown in tall towers, have been touted as a way to address potential food shortages in our growing global population.”
Address the topic of the prompt but state an obvious fact as a claim
“If the world’s population continues to grow at its current rate, we will eventually run out of arable land to grow enough food for everyone.”</td><td>Examples that earn this point:
Present a defensible position that responds to the prompt
“With the amount of farmland diminishing across the globe, vertical farms are the future of agriculture.”
“Although vertical farms may seem like a viable solution for providing food for our growing population, important factors such as cost and energy consumption prevent it from being a fully sustainable model of agriculture.”
“Because vertical farming still has some drawbacks, it should not replace traditional agricultural methods. However, vertical farming can be a good supplemental or alternative method of farming, especially in urban areas where farmland is scarce.”</td></tr>
<tr><td colspan="2">Additional Notes:
The thesis may be more than one sentence, provided the sentences are in close proximity.
The thesis may be anywhere within the response.
For a thesis to be defensible, the sources must include at least minimal evidence that could be used to support that thesis; however, the student need not cite that evidence to earn the thesis point.
The thesis may establish a line of reasoning that structures the essay, but it needn’t do so to earn the thesis point.
A thesis that meets the criteria can be awarded the point whether or not the rest of the response successfully supports that line of reasoning.</td></tr>
</table>

Reporting Category	Scoring Criteria				
Row B Evidence AND Commentary (0–4 points)	**0 points** Simply restates thesis (if present), repeats provided information, or references fewer than two of the provided sources.	**1 point** EVIDENCE: Provides evidence from or references at least two of the provided sources. AND COMMENTARY: Summarizes the evidence but does not explain how the evidence supports the student's argument.	**2 points** EVIDENCE: Provides evidence from or references at least three of the provided sources. AND COMMENTARY: Explains how some of the evidence relates to the student's argument, but no line of reasoning is established, or the line of reasoning is faulty.	**3 points** EVIDENCE: Provides specific evidence from at least three of the provided sources to support all claims in a line of reasoning. AND COMMENTARY: Explains how some of the evidence supports a line of reasoning.	**4 points** EVIDENCE: Provides specific evidence from at least three of the provided sources to support all claims in a line of reasoning. AND COMMENTARY: Consistently explains how the evidence supports a line of reasoning.
	Decision Rules and Scoring Notes				
	Typical responses that earn 0 points: • Are incoherent or do not address the prompt. • May be just opinion with no textual references or references that are irrelevant.	**Typical responses that earn 1 point:** • Tend to focus on summary or description of sources rather than specific details.	**Typical responses that earn 2 points:** • Consist of a mix of specific evidence and broad generalities. • May contain some simplistic, inaccurate, or repetitive explanations that don't strengthen the argument. • May make one point well but either do not make multiple supporting claims or do not adequately support more than one claim. • Do not explain the connections or progression between the student's claims, so a line of reasoning is not clearly established.	**Typical responses that earn 3 points:** • Uniformly offer evidence to support claims. • Focus on the importance of specific words and details from the sources to build an argument. • Organize an argument as a line of reasoning composed of multiple supporting claims. • Commentary may fail to integrate some evidence or fail to support a key claim.	**Typical responses that earn 4 points:** • Uniformly offer evidence to support claims. • Focus on the importance of specific words and details from the sources to build an argument. • Organize and support an argument as a line of reasoning composed of multiple supporting claims, each with adequate evidence that is clearly explained.
	Additional Notes: • Writing that suffers from grammatical and/or mechanical errors that interfere with communication cannot earn the fourth point in this row.				