1. As nations and space agencies have sent spacecraft and satellites into space, human-created debris—or "space junk"—has accumulated in orbit around Earth. Space debris may range in size from small parts and flecks of paint to whole defunct satellites, but all of it poses a potential risk if it collides with a spacecraft. Many countries have agreed that the management of space debris is a priority because it poses a threat to space exploration and satellites. However, removing it is difficult and costly.

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 most important factors that space agencies and nations should consider when dealing with the problem of space debris.

Source A (O'Callaghan article)

Source B (graph from ESA)

Source C (Quell article)

Source D (Rossettini opinion article)

Source E (NOAA article)

Source F (chart from Mosher and Kiersz)

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.

Source A

O'Callaghan, Jonathan. "What Is Space Junk and Why Is It a Problem?" *Natural History Museum*, nhm.ac.uk/discover/what-is-space-junk-and-why-is-it-a-problem.html.

The following is an excerpt from an article on the website of the Natural History Museum, London, which conducts scientifc research and displays scientifc findings and collections to the public.

What is space junk?

Space junk, or space debris, is any piece of machinery or debris left by humans in space.

It can refer to big objects such as dead satellites that have failed or been left in orbit at the end of their mission. It can also refer to smaller things, like bits of debris or paint flecks that have fallen off a rocket.

Some human-made junk has been left on the Moon, too.

How much space junk is there?

While there are about 2,000 active satellites orbiting Earth at the moment, there are also 3,000 dead ones littering space. What's more, there are around 34,000 pieces of space junk bigger than 10 centimetres in size and millions of smaller pieces that could nonetheless prove disastrous if they hit something else.

How does space junk get into space?

All space junk is the result of us launching objects from Earth, and it remains in orbit until it re-enters the atmosphere.

Some objects in lower orbits of a few hundred kilometres can return quickly. They often re-enter the atmosphere after a few years and, for the most part, they'll burn up—so they don't reach the ground. But debris or satellites left at higher altitudes of 36,000 kilometres—where communications and weather satellites are often placed in geostationary orbits[1]—can continue to circle Earth for hundreds or even thousands of years.

Some space junk results from collisions or anti-satellite tests in orbit. When two satellites collide, they can smash apart into thousands of new pieces, creating lots of new debris. This is rare, but several countries including the USA, China and India have used missiles to practice blowing up their own satellites. This creates thousands of new pieces of dangerous debris.

What risks does space junk pose to space exploration?

Fortunately, at the moment, space junk doesn't pose a huge risk to our exploration efforts. The biggest danger it poses is to other satellites in orbit.

These satellites have to move out of the way of all this incoming space junk to make sure they don't get hit and potentially damaged or destroyed.

In total, across all satellites, hundreds of collision avoidance maneuvers are performed every year, including by the International Space Station (ISS), where astronauts live.

Fortunately, collisions are rare: a Chinese satellite broke up in March 2021 after a collision. Before that, the last satellite to collide and be destroyed by space junk was in 2009. And when it comes to exploring beyond Earth's orbit, none of the limited amount of space junk out there poses a problem.

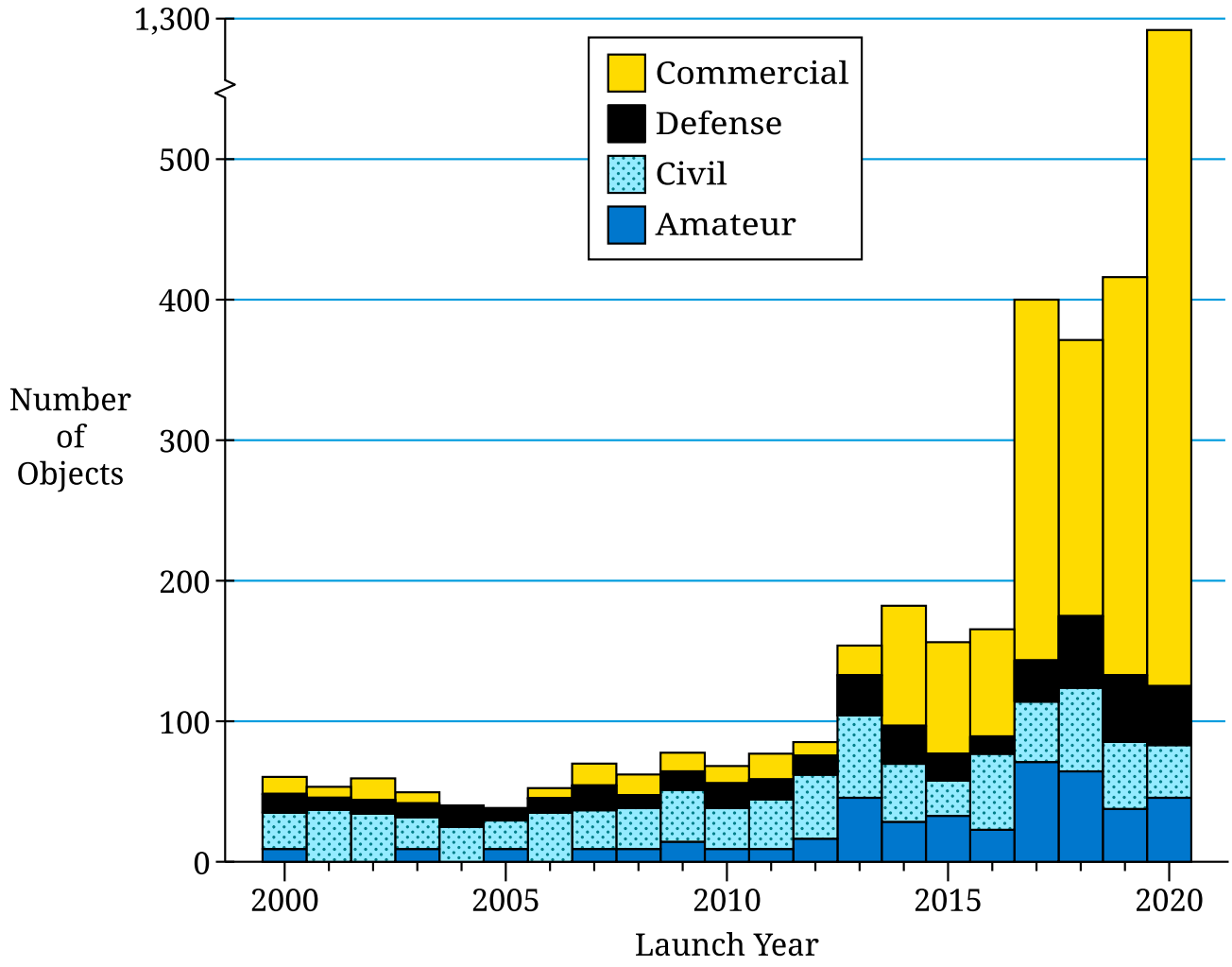
1: Satellites in geostationary orbit circle Earth above the equator following Earth's rotation.

Source B

"ESA's Space Environment Report 2021." *ESA*, The European Space Agency, esa.int/Space_Safety/Space_Debris/ESA_s_Space_Environment_Report_2021.

The following is adapted from a graph published on the website of the European Space Agency, an international organization with 22 member states.

Satellites Launched into Low-Earth Orbit



Note: Satellites are classified here according to their main source of funding.

"Commercial" indicates funding from a private business.

"Defense" indicates funding from a military source.

"Civil" indicates funding from a nonmilitary governmental source.

"Amateur" indicates funding from other sources, including private individuals and academic institutions.

Source C

Quell, Molly. "Lack of Space Law Complicates Growing Debris Problem." *Courthouse News Service*, 28 Aug. 2020, courthousenews.com/lack-of-space-law-complicates-growing-debris-problem/.

The following is excerpted from an article published by an American news service specializing in legal issues.

In total, there are five United Nations treaties that cover various aspects of space. The earliest, the Outer Space Treaty, which was ratified in 1967, has 104 signatories. It declared space free for all nations to explore and banned the use of nuclear weapons in space, a major security concern during the Cold War.

Prior to the signing of the Outer Space Treaty, each nation was considered to have sovereignty over the air above its borders. This concept was laid down in the Paris Convention of 1919, which aimed to regulate aerial travel, a new and rapidly developing industry.

Subsequent treaties—such as a 1968 agreement on the rescue of astronauts and the 1975 Registration Convention, which requires that objects launched into space be registered with a U.N. body—cover narrow aspects of space travel and have been signed by fewer than half of the world's countries.

Collisions have occurred in space. Most of them are between defunct satellites, but one 1977 crash scattered radioactive debris across Canada. A malfunction onboard the nuclear-powered Soviet spy satellite Kosmos 954 pushed it back into the Earth's atmosphere and Canada billed the Soviet Union more than 6 million Canadian dollars ($18 million today) for the damage. The two countries ultimately agreed on 3 million Canadian dollars ($9 million today).

The problem is only getting worse, said Oliver Tian, a researcher in the legal framework of space debris at the University of Leiden in The Netherlands. Nearly 9,000 satellites have been launched since the Soviet Union first sent Sputnik 1 to the Earth's orbit in 1957. SpaceX alone has launched 60 satellites this year.

Most of what goes into space doesn't come back. Nations aren't required to remove their garbage from space and to do so voluntarily would cost a tremendous amount of money. So more than half of those 9,000 satellites remain, some as operational but more as decommissioned junk. As they crash into each other, they create more tiny bits of debris whizzing around the Earth.

"Space could be inaccessible to humans," said Tian.

This worst-case scenario is known as the Kessler Effect, when the quantity of space debris created from objects crashing into one another increases until it's no longer possible to travel through it.

The European Space Agency launched its Clean Space Initiative in 2013 and has commissioned the first debris removal mission, scheduled for 2025. Together with the Swiss tech startup Clear Space, the ESA plans to use robotic arms to capture part of a rocket and deorbit it to the Earth's atmosphere, where it will burn up on reentry.

"This is an environmental problem," said Schrogl. "What is happening on Earth is happening in space."

Despite the growing problem, the ESA's chief strategy officer is optimistic. Unlike other issues facing humanity—climate change, poverty, war—the ones surrounding space debris have clear and straightforward solutions. If, that is, countries are willing to get together and act.

"It is a solvable problem," Schrogl said.

Courtesy of Courthouse News Service

Source D

Rossettini, Luca. "Space Debris: Prevention, Remediation or Mitigation?" *SpaceNews*, 3 Mar. 2015, spacenews.com/op-ed-space-debris-prevention-remediation-or-mitigation/.

The following is an excerpt from an opinion article published in an online newsletter that focuses on the analysis of factors and trends shaping the global space industry. The author is the chief executive and cofounder of a start-up company dedicated to addressing the space debris problem.

What is the best strategy to stop the increasing concentration of junk around the planet?

Passive and active devices can be installed on satellites to remove them at the end of their missions. Some envision an active debris removal (ADR) mission to go grab a dead satellite and remove it. There are even studies for refurbishing missions, where a robotic space vehicle would grab a satellite nearing its end of life to refuel and service it. Nearly all of these plans are real only on paper.

Effort and money are being spent today on the development of ADR missions, a remediation technique focused on eliminating the garbage that is already in space. These technologies, once developed, will permit spacecraft to grab large or small satellites and remove them from orbit. Unfortunately there are still several criticalities to face. There are political and legal issues related to the ownership of defunct satellites that prevent, for example, a European ADR vehicle from disposing of an Indian satellite without permission. There are also technology development challenges, like the need to capture a noncooperating target. Finally, there is the cost of every single mission that will be paid by taxpayers. Moreover, according to some experts, we need to remove about 10 big satellites per year to significantly reduce the collision risk. With more than 100 satellites launched into space every year, pulling 10 down does not get us closer....

Mitigation is the process of reducing the likelihood that a specific object will cause more debris. It involves passivation[1] of rocket bodies and decommissioned spacecraft—venting pressure vessels and fuel tanks and discharging batteries to prevent explosions in space. These fundamental measures are quite well implemented in all the new satellites launched.

But once more, mitigation measures by themselves don't get us any closer still.

In the end we can't limit ourselves to "reducing," "remediating" or "mitigating" if what we ultimately want is to operate in a clean space, where operators are not bothered by other threatening man-made objects approaching their assets.

We should first make sure that every new satellite and launch vehicle is properly and effectively removed at the end of life. Then we can start removing the defunct satellites already in space. Finally, we may think about recycling and reusing spent satellites already in space.

Therefore, prevention is the first action to be put in place, while we develop effective and efficient technologies for the ADR missions. Tethers, balloons, solar sails and active decommissioning devices are all examples of systems that can be installed on satellites before launch to increase the chances of being able to dispose of them at the end of life. Whatever is ready and available today is better than doing nothing. No more dead satellites such as DMSP-F13 should be left uncontrolled in orbit, representing a risk to operative satellites due to possible collisions and to the safe access to space of incoming missions.

1: in engineering, a process that makes a material less vulnerable to corrosion or other interaction with its environment

Source E

National Environmental Satellite, Data, and Information Service. "Does Space Junk Fall from the Sky?" *National Oceanic and Atmospheric Administration*, 19 Jan. 2018, www.nesdis.noaa.gov/news/does-space-junk-fall-the-sky.

The following is an excerpt from an article published on a National Oceanic and Atmospheric Administration (NOAA) website devoted to providing environmental data gathered from satellites.

Despite their size, even the smallest of objects, some of which cannot be detected by sensors, can be hazardous to unmanned and manned spacecraft. This is because they are orbiting at extremely high velocities. This is faster than a bullet, which means that the debris can easily punch through the protective covering on satellites or spacecraft.

While space debris is rarely a concern for humans on Earth, our satellites in the sky often have to avoid its dangerous path.

NOAA / NASA Suomi NPP Satellite Avoids Head On Collision at 35,000 mph

For example, on an otherwise quiet Sunday in September 2014, the Suomi NPP mission team was monitoring the possible close approach of a debris object (which was determined to be between 4 inches and 3.3 feet in size range). By early evening, the risk was assessed to be high enough to start planning to maneuver the satellite into a safer zone.

The team determined that the small space debris object was traveling at a rate of almost 17,000 mph directly towards Suomi NPP. They calculated that if no action was taken, it was likely to miss the satellite by just 300 feet on Tuesday, September 30. With that knowledge, the decision was made at 1:30 p.m. on Monday, September 29, for NOAA's Satellite Operations Facility, or NSOF, in Suitland, Maryland, to reposition Suomi NPP.

"Because Suomi NPP moves at a similar speed as the debris object, if there had been an impact, it would have occurred at a combined speed of nearly 35,000 mph. This would have been catastrophic not only to the satellite, but would result in thousands of pieces of new debris," said Harry Solomon, Mission Manager for NOAA/NASA Suomi NPP.

Since Suomi NPP's launch in October 2011, it has successfully completed a few Risk Mitigation Maneuvers to avoid space debris!

Where to Safely Crash Space Junk? The Most Remote Place on Earth!

In a global effort to reduce space debris, many satellite mission teams are able to safely maneuver retired satellites back into Earth's atmosphere so that one of two things occur. For satellites orbiting close to Earth, operators lower the orbit of a decommissioned satellite so that it will naturally re-enter the atmosphere within 25 years (known as the "25-year Rule"). As the satellite begins to fall back toward Earth and loses altitude, the compression and friction in the dense region of the atmosphere closest to the Earth generates a lot of heat which breaks up and burns most of the satellite machinery.

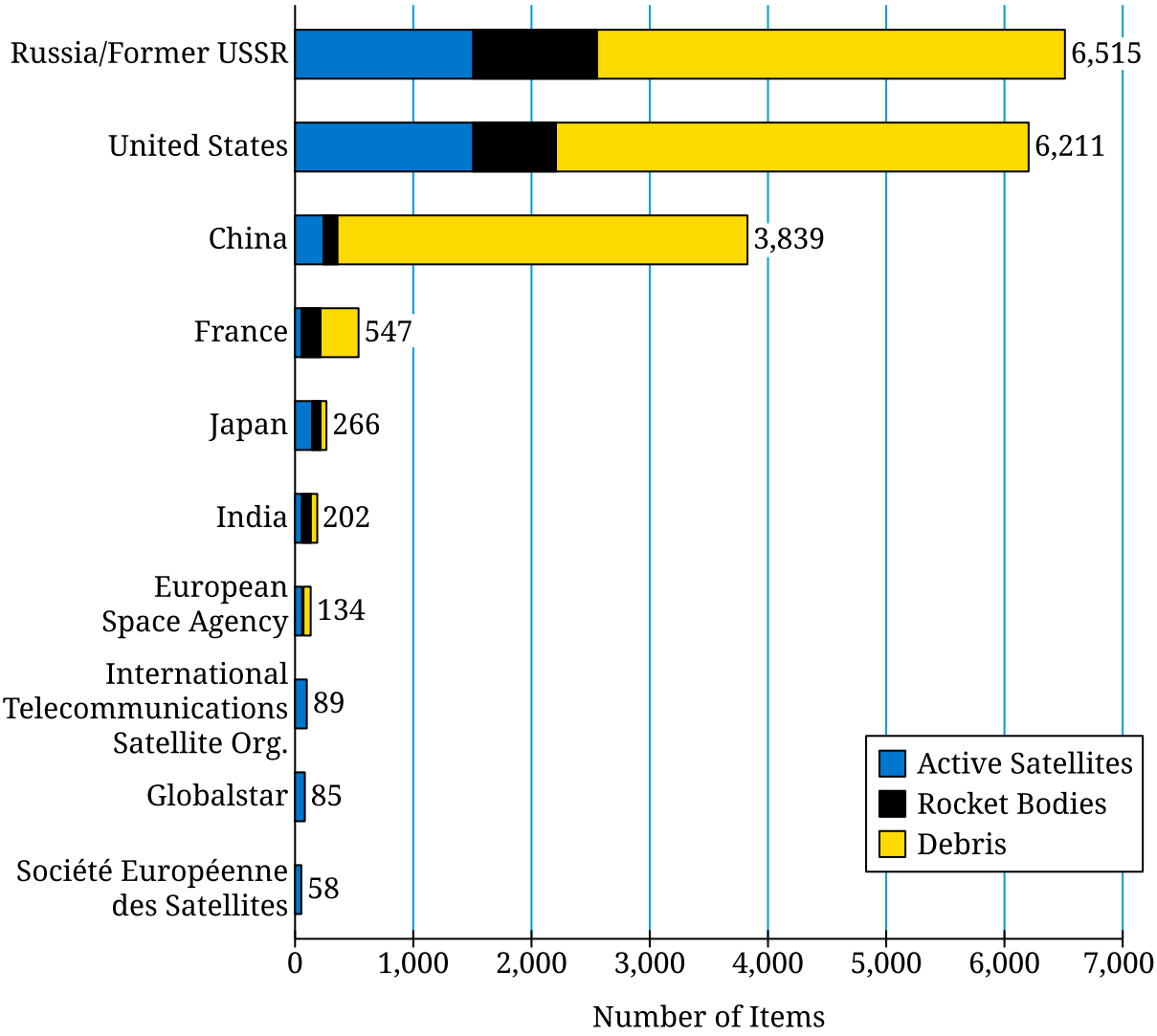
Or, if the satellite has enough fuel, it can fly back through the atmosphere and be crashed into the ocean. This Pacific Ocean location has many names, Point Nemo (which is Latin for 'no one') and the Oceanic Pole of Inaccessibility. The nearest land mass is 1,450 nautical miles away.

Source F

Mosher, Dave, and Andy Kiersz. "These Are the Countries on Earth with the Most Junk in Space." *Business Insider*, 20 Oct. 2017, businessinsider.com/space-debris-garbage-statistics-country-list-2017-10.

The following is a chart based on an image published in an online business magazine.

Countries and Agencies with the Most Stuff in Orbit



Note: The European Space Agency is an intergovernmental organization devoted to space exploration. The International Telecommunications Satellite Organization is an international regulator of satellite services. Globalstar and Société Européenne des Satellites are private telecommunications providers.

1. Mapping software and Global Positioning System (GPS) devices are used regularly by travelers and commuters. Since these devices and apps are updated in real time with user-supplied information, they have become associated with a number of problems. While commuters attempt to avoid traffic on highways, they often create traffic on smaller, local roads that are less able to handle this new burden. Users also lose a sense of their geographical surroundings as they rely more on mapping software or GPS devices for navigation.

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 mapping software and devices.

Source A (Foderaro article)

Source B (National Research Council book)

Source C (graph from He)

Source D (Grabar article)

Source E (chart from BuildFire)

Source F (Paulas article)

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.

Source A

Foderaro, Lisa W. "Navigation Apps Are Turning Quiet Neighborhoods Into Traffic Nightmares." *The New York Times*, 24 Dec. 2017, www.nytimes.com/2017/12/24/nyregion/traffic-apps-gps-neighborhoods.html.

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

It is bumper to bumper as far as the eye can see, the kind of soul-sucking traffic jam that afflicts highways the way bad food afflicts rest stops.

Suddenly, a path to hope presents itself: An alternate route, your smartphone suggests, can save time. Next thing you know, you're headed down an exit ramp, blithely following directions into the residential streets of some unsuspecting town, along with a slew of other frustrated motorists.

Scenes like this are playing out across the country, not just in traffic-choked regions of the Northeast. But one town has had enough.

With services like Google Maps, Waze and Apple Maps suggesting shortcuts for commuters through the narrow, hilly streets of Leonia, N.J., the borough has decided to fight back against congestion that its leaders say has reached crisis proportions.

In mid-January, the borough's police force will close 60 streets to all drivers aside from residents and people employed in the borough during the morning and afternoon rush periods, effectively taking most of the town out of circulation for the popular traffic apps—and for everyone else, for that matter.

"Without question, the game changer has been the navigation apps," said Tom Rowe, Leonia's police chief. "In the morning, if I sign onto my Waze account, I find there are 250,000 'Wazers' in the area. When the primary roads become congested, it directs vehicles into Leonia and pushes them onto secondary and tertiary roads. We have had days when people can't get out of their driveways."...

Waze defends its practice of rerouting motorists from congested highways through residential streets in nearby communities. And the company says it shares free traffic data with municipal planners nationwide who might, for instance, want to monitor the effectiveness of a new time sequence for a traffic signal.

Terry Wei, a spokeswoman for Waze, said the app benefited from a community of local volunteer editors who ensure that the maps stay up-to-date and reflect the local law. "If a road is legally reclassified into a private road," she said, "our map editors will make that change. It is our goal to work holistically with our community of drivers, map editors and city contacts to improve the driving experience for all."

Source B

National Research Council. *Understanding the Changing Planet: Strategic Directions for the Geographical Sciences*, 2010, doi.org/10.17226/12860.

The following is excerpted from a book about geographical sciences.

The popularity of Web mapping sites such as Google Maps, Google Earth, and Microsoft Virtual Earth has exploded in recent years. Particularly in wealthier parts of the world, these sites have become a central part of daily life (the "next utility") as they are used to navigate to places of work, pleasure, and commerce, and to allow citizens to increase their knowledge of the world. Not only do people want to receive information from these sites; they increasingly want to share it as well. Sites, such as Wikimapia.org, OpenStreetMap.org, MapAction.org, and Flickr.com are empowering millions of citizens to create a global patchwork of geographical information. This information is already serving society in many ways—assisting in local tourism and community planning, disaster response (e.g., citizen maps of Southern California fires), humanitarian aid, habitat restoration, public health monitoring, and personal assessments of environmental impacts. This citizen mapping "workforce" is largely untrained, under no authority, and the mapping is often done for no obvious reward (Goodchild, 2007).

Goodchild (2007) terms this recent phenomenon "volunteered geographic information" (VGI), wherein a private citizen participates in the creation, assembly, and dissemination of geographical information on the Web. The information is "volunteered" primarily by adding a geographical identifier (known also as a geotag) to a Wikipedia article, photograph, or video, or by adding one's own geographical data to an interactive, Web-based map, often by marking locations of certain features that are of importance, places where various events have occurred, or places where an individual has been or would like to go ... For those with more advanced computing skills, Google Earth and other virtual globes are providing ways for citizen mappers (known also as neogeographers) to develop their own mapping applications, such as geoGreeting, which create greeting messages in Google Maps spelled out in satellite images of real buildings from all over the world that happen to be shaped as letters when viewed from above. VGI can be a boon, for example, to international development and humanitarian relief organizations, which can supply these organizations with the most up-to-date detailed data....

The power of such Web sites to increase the efficiency, pleasure, and safety of our lives is becoming increasingly apparent.

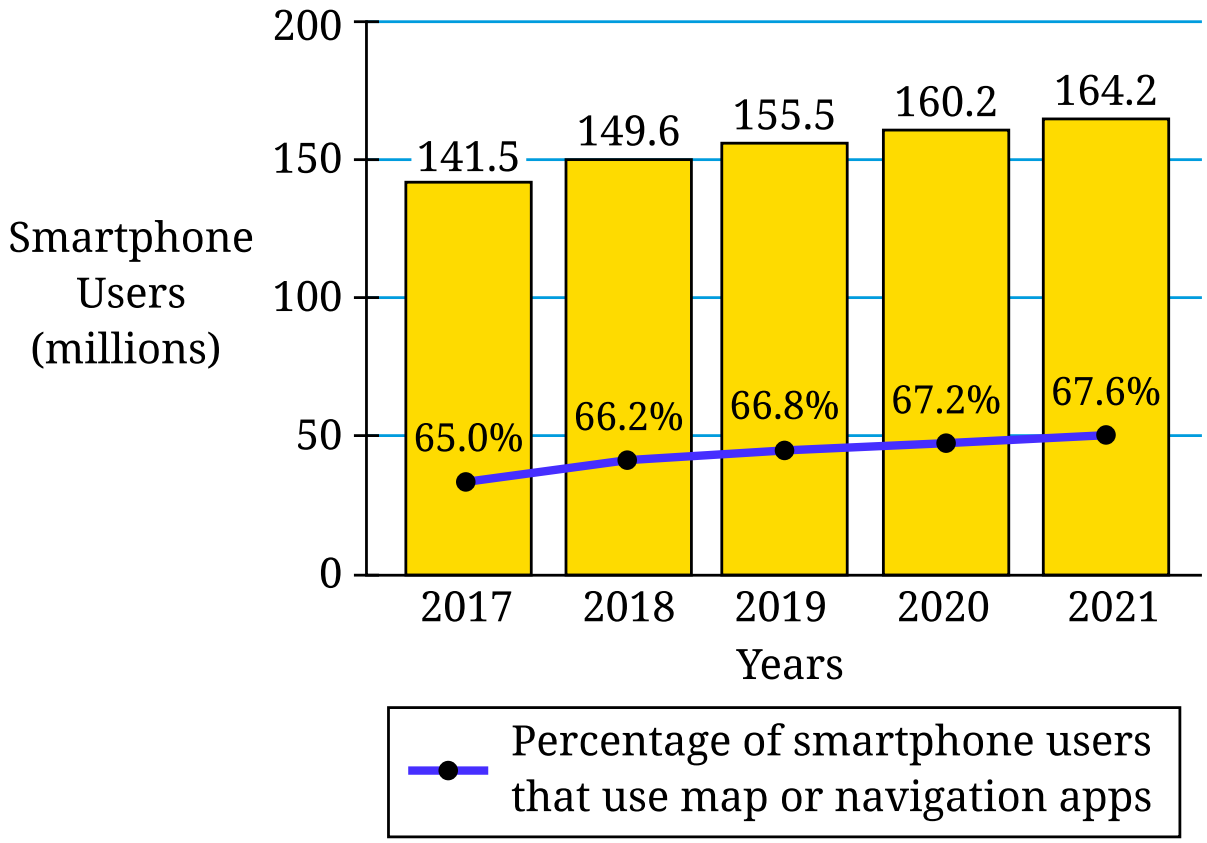
National Research Council. 2010. *Understanding the Changing Planet: Strategic Directions for the Geographical Sciences*. doi.org/10.17226/12860. Reprinted with permission by the National Academy of Sciences, Courtesy of the National Academies Press, Washington, D.C.

Source C

He, Amy. "People Continue to Rely on Maps and Navigational Apps." *Insider Intelligence*, 18 July 2019, www.emarketer.com/content/people-continue-to-rely-on-maps-and-navigational-apps-emarketer-forecasts-show.

The following is adapted from a graph published in an article forecasting market trends.

Smartphone Map/Navigation App Users (US, 2017–2021)



Source D

Grabar, Henry. "Smartphones and the Uncertain Future of 'Spatial Thinking.'" *Bloomberg*, 9 Sept. 2014, www.bloomberg.com/news/articles/2014-09-09/smartphones-and-the-uncertain-future-of-spatial-thinking.

The following is excerpted from an online business magazine.

Wayfinding[1] is certainly easier than ever before. The advent of self-driving cars, projected to make up a sizable share of the American auto market by 2030, represents the culmination of the cartographer's ancient quest to eliminate human effort and error from navigation. Even the classic dashboard GPS, according to Nick Cohn, a traffic expert at TomTom, induces a state of rest. "The overall effect is that people are more calm when they're using navigation," he says. By extension, they drive safer.

Your brain is indeed relaxing. In a handful of studies conducted over the last decade in the United States, England, Germany and Japan, researchers have shown that GPS navigation has a generally pernicious[2] effect on the user's ability to remember an environment and reconstruct a route. Toru Ishikawa, a spatial geographer at the University of Tokyo, quantified the difference in a study published earlier this year. Asked to recall various aspects of their surroundings, participants using GPS navigation performed 20 percent worse than their paper-map peers.

As Ishikawa pointed out to me, these findings raise questions beyond urban anthropology. Spatial thinking helps us structure, integrate, and recall ideas. It's less an independent field of study than a foundational skill; a 2006 report from the National Research Council called spatial literacy the "missing link" in the K-12 curriculum at large.

Navigating is among the greatest incubators of that ability. A sophisticated internal map, as a famous study of London cab drivers showed, is tied to greater development in the hippocampus, the brain region responsible for spatial memory. In another study, participants with stronger hippocampus development tended to navigate with complex cognitive maps, while those with less developed spatial memory memorized turn-by-turn directions.

Isn't it ironic: the easier it is for me to get where I'm going, the less I remember how I got there. As a conscious consumer of geographic information, should I be rationing my access to navigation tools—the mental equivalent of taking the stairs instead of taking the elevator?

1: the process of navigating to a destination
2: harmful

Source E

"Mobile App Download and Usage Statistics (2024)." *BuildFire*, n.d., buildfire.com/app-statistics/.

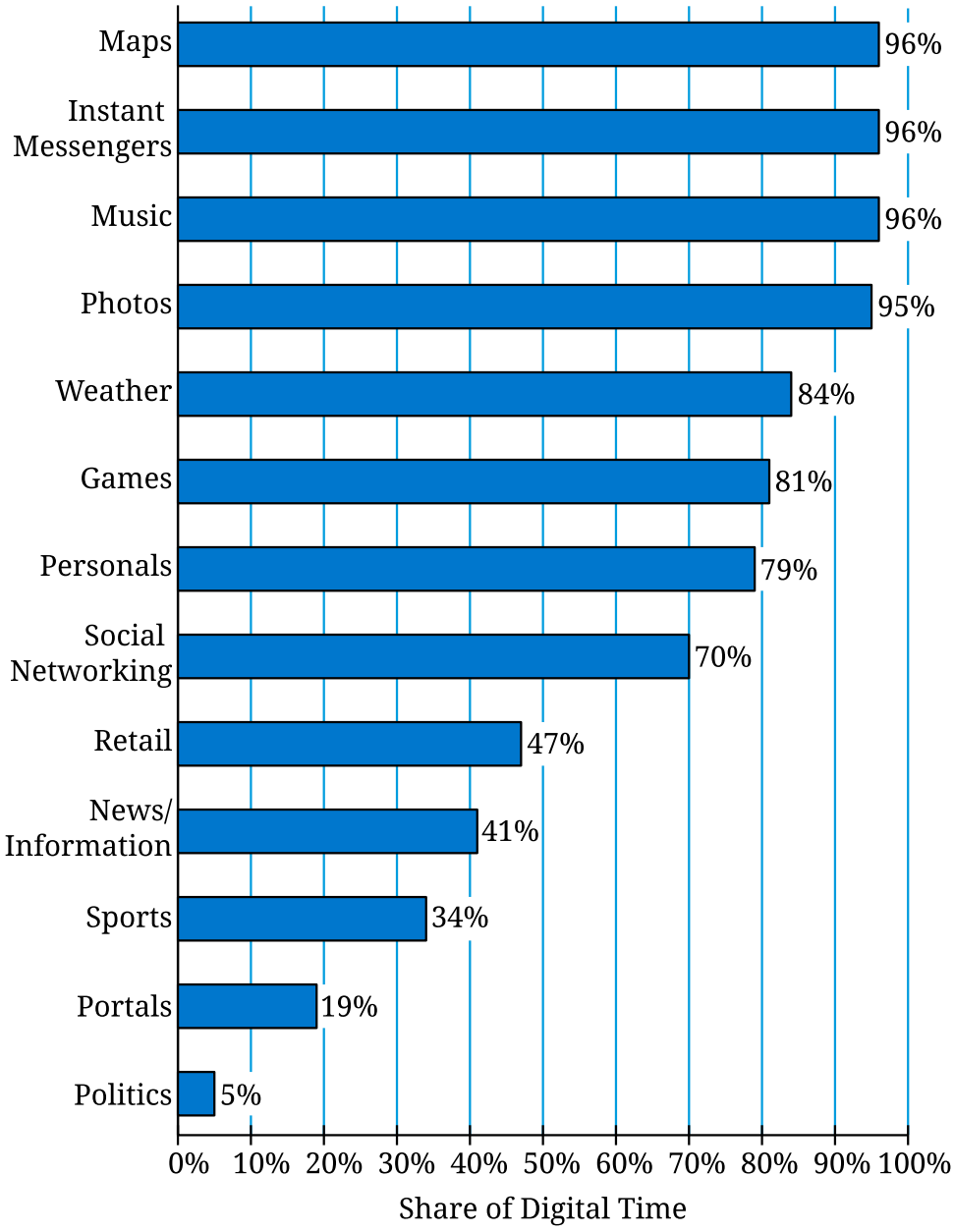
The following is adapted from a chart of digital application usage published on an app developer website.

Digital content can be consumed from so many devices.

People have smartphones, tablets, desktop computers, and laptops. You can even access content and apps from smart TVs, watches, smart home devices, and smart vehicles.

But there are certain categories that are dominated with smartphone app usage. These are the top categories that people turn to their smartphones for.

Smartphone App Usage



Source F

Paulas, Rick. "For the Good of Society—and Traffic!—Delete Your Map App." *Intelligencer*, Vox Media, 11 Dec. 2017, nymag.com/intelligencer/2017/12/waze-and-google-maps-create-traffic-in-cities.html.

The following is excerpted from an article published in an online magazine.

Pull up a simple Google search for "neighborhood" and "Waze," and you're bombarded with local news stories about similar once-calm side streets now the host of rush-hour jams and late-night speed demons. It's not only annoying...it's a scenario ripe for accidents; among the top causes of accidents are driver distraction (say, by looking at an app), unfamiliarity with the street (say, because an app took you down a new side street), and an increase in overall traffic.

"The root cause is the use of routing apps," says Bayen, "but over the last two to three years, there's the second layer of ride-share apps."

It's worth breaking down the layers. The first is the large number of drivers that utilize the apps, a percentage that grows by the day. In 2011, Waze had 7 million downloads; that number climbed to 50 million by 2013, and 65 million in 185 countries by 2016. Meanwhile, Google Maps has well over 1 billion monthly users.

The second, newer layer is the fleet of ride-share vehicles. There are an estimated 45,000 Uber and Lyft drivers in San Francisco, compared to 1,500 cab drivers. The two ride-sharing titans have each designed their own mapping apps—Lyft Navigation and Uber Driver—but Navigation was built using Google Maps, and Uber's app has yet to be fully rolled out...Whatever the device, it's one dictated on concrete route efficiency, as opposed to the whims of cab drivers, who use thoroughfares or "their own" shortcuts.

All that extra traffic down previously empty streets has created an odd situation in which cities are constantly playing defense against the algorithms.

"Typically, the city or county, depending on their laws, doesn't have a way to fight this," says Bayen, "other than by doing infrastructure upgrades."

Fremont, California, has lobbed some of the harshest resistance, instituting rush-hour restrictions, and adding stop signs and traffic lights at points of heavy congestion. San Francisco is considering marking designated areas where people can be picked up or dropped off by ride-shares....Los Angeles has tinkered with speed bumps and changing two-way streets into one-ways....

My favorite coalition of grumps have been the residents of Takoma Park, Maryland, who actually spent time falsifying accident reports to Waze in order to prompt the algorithm to shift the route elsewhere. But all of the actions, either infrastructure changes performed by the city or hacks by community groups, have the same intended purpose: "I will make driving through our neighborhoods more difficult, so you will not use the street," says Jeff Ban, a professor of civil and environmental engineering at the University of Wisconsin.

Perhaps you see the problem. If cities thwart map apps and ride-share services through infrastructure changes with the intent to *slow traffc down*, it has the effect of *slowing down traffc*. So, the algorithm may tell drivers to go down another side street, and the residents who've been griping to the mayor may be pleased, but traffic, on the city whole, has been negatively affected, making *everyone's* travel longer than before.

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.)

Historic preservation laws are intended to protect buildings deemed to be of historic, cultural, or architectural value. The laws affect both government buildings and private property, putting constraints on how and to what extent the structures can be altered, renovated, or replaced. Proponents of these laws claim they are necessary for the preservation of history and culture and the architectural integrity of a neighborhood. Opponents of the laws argue that such laws prevent progress and negatively impact real estate development, building renovation, and building design.

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 laws designed to preserve buildings deemed to be of historic importance.

Source A (National Park Service Web site)
Source B (Merlino book)
Source C (Appelbaum opinion article)
Source D (Webb graph)
Source E (Martin article)
Source F (Rosen cartoon)

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.

Source A

"National Historic Preservation Act." *National Park Service*, U.S. Department of the Interior, 2 Dec. 2018, nps.gov/subjects/historicpreservation/national-historic-preservation-act.htm.

The following is excerpted from a Web site maintained by the United States National Park Service.

After World War II, the United States seemed poised at the edge of a limitless future, and its vision of progress was characterized by the sleek and the new. Urban renewal was seen as a way to clear out the slums, get rid of "obsolete" buildings, make space for an exploding population, and accommodate the burgeoning car culture. Wide swaths were demolished: entire blocks, neighborhoods, business districts, all razed to make way for the new. By the 1960s, urban renewal had altered the face of the nation's cities.

But out of this wholesale erasure of the old grew the most important law governing how we treat those places that define our past: the National Historic Preservation Act. It was the first national policy governing preservation and it would shape the fate of many of our historic and cultural sites over the next half-century. There had been earlier measures to foster preservation—the Antiquities Act of 1906 and the Historic Sites Act of 1935—but none were as sweeping or as influential as the National Historic Preservation Act.

In 1965, President Lyndon B. Johnson convened a special committee on historic preservation. The committee studied the dismal situation, then delivered a report to Congress. Their report, called *With Heritage So Rich*, became a rallying cry for the preservation movement. Up until that time, the National Park Service's Historic American Buildings Survey (HABS) had documented 12,000 places in the United States. By 1966, half of them had either been destroyed or damaged beyond repair. . . .

Before the year was out, Congress passed the National Historic Preservation Act. It was the most comprehensive preservation law the nation had ever known. The act established permanent institutions and created a clearly defined process for historic preservation in the United States.

Historic structures that would be affected by federal projects—or by work that was federally funded—now had to be documented to standards issued by the Secretary of the Interior. The law required individual states to take on much more responsibility for historic sites in their jurisdictions. Each state would now have its own historic preservation office and was required to complete an inventory of important sites. The law also created the President's Advisory Council on Historic Preservation and the National Register of Historic Places, an official list not only of individual buildings and structures, but also of districts, objects, and archeological sites that are important due to their connection with the past. . . .

With the passage of the act, preservation in the United States became formalized and professionalized. The National Historic Preservation Act was tied to a growing awareness of the past and of community identity. Many communities realized that there was an unexpected economic force behind preservation. The act helped foster heritage tourism, attracting visitors who wanted to experience the past in ways that no book or documentary could match. The distinctive character of old architecture and historic districts became a powerful draw for many Americans, and antidote to anonymous suburbs and strip malls.

Source B

Merlino, Kathryn Rogers. *Building Reuse: Sustainability, Preservation, and the Value of Design.* University of Washington Press, 2018.

The following is excerpted from a book advocating for more reuse of existing buildings.

In the United States, the recognition of value in buildings began with the identification and preservation of historical structures that had played an important part of the story of creating our nation. Historic designation usually takes into consideration national standards of significance set within specific boundaries: to be designated, a building must be proven to be associated with an important moment in local or national history, or with a historical individual or group, or must represent an exceptional architectural style or tradition. Of course, the question of what should be considered "significant" historical and cultural value in a building is often hotly debated by owners, historians, politicians, community groups, and other interested parties. When the terms of significance can't be established or agreed upon, it becomes practically impossible to "officially" declare something historic—and suddenly, the building lacks "value." For this reason, basing preservation decisions solely on whether a building has been designated as "historic" significantly limits the way we value and preserve existing buildings. In effect, the word *historic* saves them, but *old* or *existing* does not, and anyone who wants to demolish a building can simply argue that the building lacks historical significance. Considering that "nonhistoric" buildings comprise the vast majority of our existing building stock, we need to broaden our definition of *value* if we are to maintain cultural and environmental sustainability.

Attaching value to buildings exclusively for their architectural, cultural, or historic significance is problematic in three ways. First, only buildings with the highest historic status are considered valuable enough to be protected from demolition, but this type of building represents only a small percentage of designated buildings. As a result, the majority of historic designations are primarily honorific; and while they provide financial incentives for maintaining a building's character and may give it greater stature and recognition, they do not protect it from demolition. Second, the historic designation process is piecemeal and irregular—and therefore complicated, time-consuming, and discouraging. The result is that only a small fraction of eligible buildings are even nominated, and those that win registry constitute a tiny portion of the buildings that—by the same standards—would qualify. Finally, attaching value to buildings exclusively because of their notarized historical significance ignores the fact that all buildings inherently hold value as *environmental* artifacts. They are repositories of extracted and manufactured materials and represent expended energy and carbon emissions; and as such, they hold great value as environmental resources. Consequently, while we rigorously recycle our paper, glass, and metal, we do not apply this ethic to our largest manufactured artifacts, our buildings. Regarding our existing building stock as an environmental resource is essential to advancing any agenda of sustainability.

The opportunities that older buildings offer are enormous. Older buildings not only have worth as resources of materials but also can be retrofitted with energy-efficient technologies for high performance. In fact, some older buildings already have a head start. Studies show that many older buildings already perform as well as or better than new buildings by many measures.

Source C

Appelbaum, Binyamin. "When Historic Preservation Hurts Cities." *The New York Times*, 26 Jan. 2020, nytimes.com/2020/01/26/opinion/historic-preservation-solar-panels.html.

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

I live in a historic neighborhood in the heart of Washington, D.C. It's not historic in the sense that anything especially important happened here—certainly not in the modest rowhouses that make up the bulk of the neighborhood. What "historic" means, here and in cities across the country, is that this is a neighborhood where buildings are not supposed to change.

The law says window frames on Capitol Hill must be wooden, or something that looks very much like wood. If a front door has two parts and opens down the middle, it cannot be replaced by a single door that swings open from the side. If the house was built two stories tall, it must remain two stories tall—unless the addition can't be seen from the street.

Humans don't like change, so it's not surprising that historic preservation laws have become quite popular. There are now more than 2,300 local historic districts across the United States, and I know many people who would like to have their own neighborhood frozen in time.

But historic preservation comes at a cost: It obstructs change for the better. And while that price is generally invisible, it is now on public display because of the city's efforts to prevent Washington homeowners in historic neighborhoods from installing visible rooftop solar panels. . .

"I applaud your greenness, and your desire to save the planet . . ." Chris Landis, an architect who sat on one of the boards that pass judgment on proposed changes to Washington homes, told a homeowner in October who had the temerity to request permission to install 12 front-facing solar panels on his own roof. "But I just have this vision of a row of houses with solar panels on the front of them and it just—it upsets me, as somebody who's supposed to protect the architectural fabric of a neighborhood."

Source D

Webb, Amy. "Building Relevance: What Are the Top Challenges Facing Preservation?" *National Trust for Historic Preservation: Preservation Leadership Forum*, 8 Oct. 2020, forum.savingplaces.org/blogs/amy-webb1/2020/10/08/survey-top-challenges-facing-preservation.

The following is based on a graph from a survey on preservation, conducted by a nonprofit organization dedicated to preserving historic structures. The graph shows historic preservation professionals' responses to the question "What are the top challenges to preserving historic places?"

While survey respondents identified a broad range of issues, the top seven preservation challenges as of the fall of 2019 . . . included:

1. Need for funding

2. Need to communicate the relevancy of preservation

3. Pressures from new development

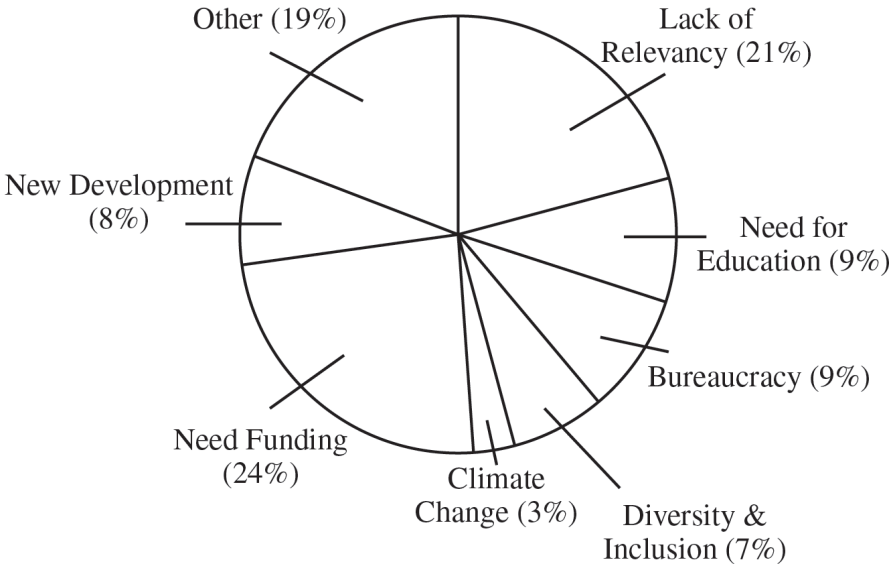
4. Bureaucratic [complicated administrative] nature of some preservation processes

5. Need to educate the next generation of preservationists, particularly in the preservation trades

6. Lack of diversity in the preservation movement

7. Risks posed by climate change

WHAT ARE THE TOP CHALLENGES TO PRESERVING HISTORIC PLACES?



Source E

Martin, Shayla. "Can a Grassroots Movement Save Harlem's Culturally Rich Buildings? We Talked to the Women Preserving the Neighborhood's History." *Veranda*, 19 Aug. 2021, veranda.com/home-decorators/a37189748/preservation-of-harlem/.

The following is excerpted from an article published in a magazine focused on home design.

Valerie Jo Bradley is one of the cofounders of Save Harlem Now!, a nonprofit advocacy group that formed to preserve buildings and landscapes that contain important African American history from the early 20th century. "We realized we've got to be organized and proactive to deal with the fact that only 3.7 percent of Harlem's buildings are landmarked compared to 66 percent of Greenwich Village and 50 percent of the Upper West and Upper East sides."

Since its establishment in 2015, the group has worked with the Landmarks Preservation Commission to designate key buildings and historic districts for legal protection (among them, the rowhouse-rich area of West 130th and 132nd streets between Lenox Avenue and Adam Clayton Powell Jr. Blvd.; the Harlem branch of the New York Public Library, frequented by [Langston] Hughes and fellow writer James Baldwin, is also on their list). This year, Save Harlem Now! received a grant from the National Trust for Historic Preservation's African American Cultural Heritage Action Fund to bolster their preservation efforts.

And not a moment too soon. Since the early aughts,[1] development in Harlem has ramped up, replacing endemic boutiques, coffee shops, grocery stores, and even the architectural vernacular itself with mirrors of other urban landscapes.

"[Bradley] sees historic district designation as a way to slow down development trends, or at least to ensure that the physical history and cultural legacy is retained in Harlem, and I agree with her," says Brent Leggs, executive director of the Action Fund. "Preservation is people-centered. Although we're using old things—old buildings, old stories—it's really about leveraging the power of place to have a positive impact on people's lives right now in the present moment," Leggs adds. "A lot of our work examines the different tools that can be used to mitigate both racial and cultural displacement. And the preservation efforts happening now in Harlem really highlight the ways that the culture is retained."

Of course, preservation alone will not stave off gentrification,[2] but it's an essential component, adds Darren Walker, president of the Ford Foundation and co-chair of the National Advisory Council of the Action Fund. "Without ensuring that people have access to critical resources like affordable housing and good jobs in their communities, we won't be able [to] preserve the essence of what makes places like Harlem so special: its residents."

Under Walker's leadership, the Ford Foundation's America's Cultural Treasures Initiative has made unprecedented investments in significant arts centers in Harlem, including the Apollo Theater, Dance Theatre of Harlem, and the Studio Museum in Harlem. "We want these anchors of our community—and the people who live there—to remain resilient and not get swept away in the tidal wave of gentrification Harlem is experiencing," he says. Also on Walker's list: keeping larger cultural institutions rooted in Harlem, places like

the Schomburg Center for Research in Black Culture, one of the leading worldwide archives for information on people of African descent, and Mother AME Zion Church, the oldest African American church in New York City.

[1] early 2000s

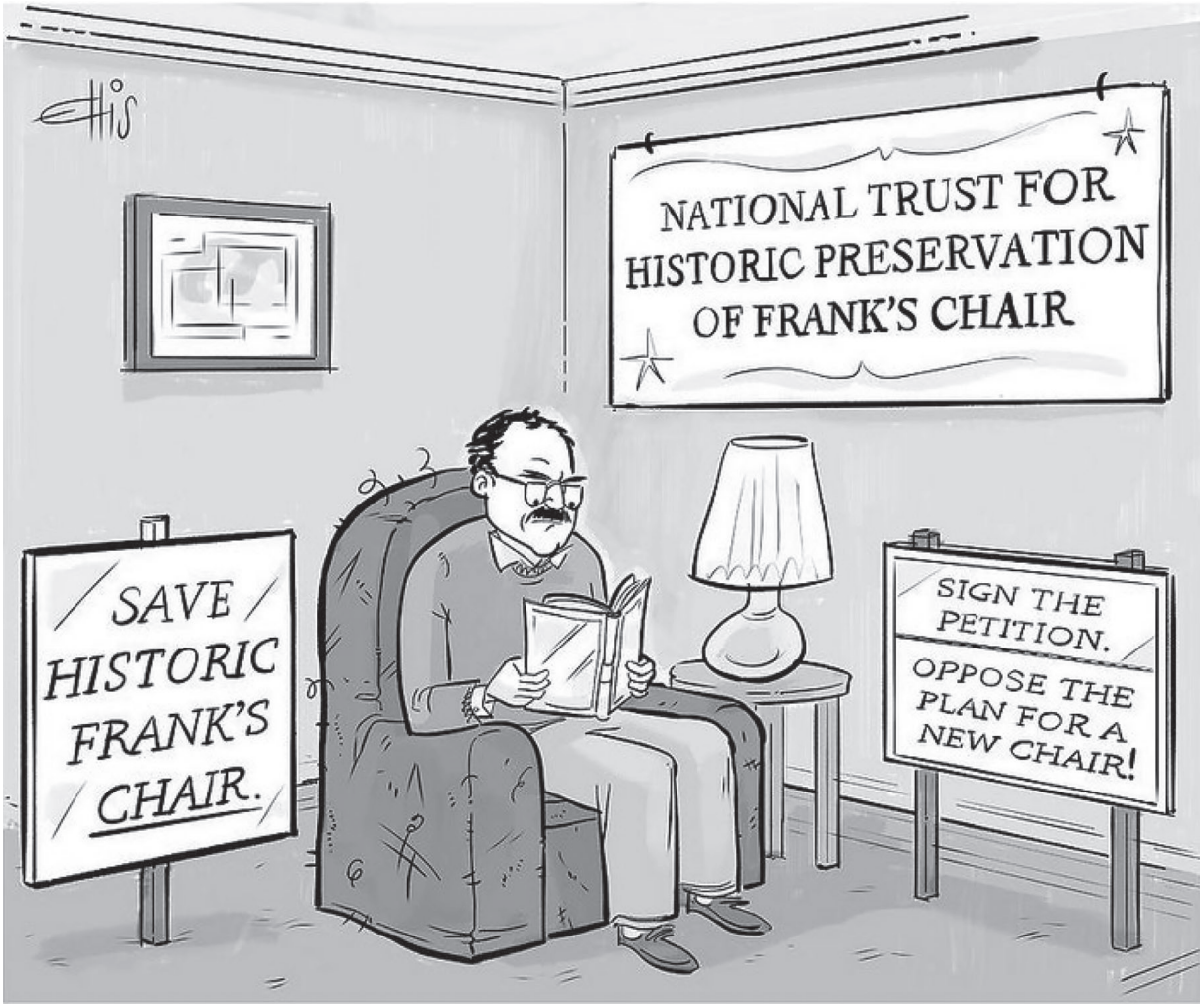
[2] process in which a neighborhood or area is changed or renovated through the influx of middle-class residents and businesses, often displacing the original residents of the area

by Shayla Martin, *Veranda*, Hearst Magazine Media, Inc.

Source F

Rosen, Ellis. "National Trust for Historic Preservation of Frank's Chair." *New Yorker Collection*, 3 Jan. 2022, condenaststore.com/featured/national-trust-for-historic-preservation-of-franks-chair-ellis-rosen.html.

The following is a cartoon from the collection of a weekly magazine of journalism and culture.



Ellis Rosen
The New Yorker Collection
The Cartoon Bank; © Condé Nast

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.

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.)

Mobile food service establishments, such as food trucks and food carts, have become increasingly trendy in recent years, offering customers appealing and often innovative dining options out of vehicles that can easily be located near workplaces and leisure activities. These businesses have sometimes been held back from expanding because of local regulations that restrict their activities and require operators to obtain licenses and certifications. Proponents of these regulations say that laws are needed to ensure that the meals offered by mobile food services are safe and that these businesses do not have an unfair advantage over traditional restaurants.

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 what are the most important factors for cities to consider when regulating mobile food service establishments.

Source A (Baker article)
Source B (New Orleans permit guide)
Source C (U.S. Census Bureau graph)
Source D (Meehan article)
Source E (Neseman cartoon)
Source F (Weber book)

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.

Source A

Baker, Linda. "Food Trucks 'Are No Longer a Novelty,' but They Are Adapting." *New York Times*, 5 Feb. 2019, www.nytimes.com/2019/02/05/business/food-truck-expansion-entrepreneurship.html.

The following is excerpted from a newspaper article about the food truck industry.

Enticing hungry customers and luring celebrity backers, food trucks have been quickly expanding nationwide for the last decade. But in pioneering cities like Austin, Tex., and Portland, Ore., the industry is feeling growing pains as fickle customers move on and regulators clamp down.

So entrepreneurs are finding new locations to park their mobile restaurants.

Last October, a development team created a new dining concept in an up-and-coming neighborhood of Charleston, S.C. Called the Container Bar, it features a bar constructed from a shipping container with space for four food trucks that rotate daily.

"Charleston has a reputation of being a culinary mecca, but it is unique in that there are no spaces for food trucks to congregate," said Brad Creger, one of three Container Bar owners. The others are Mike Veeck, president of the Charleston RiverDogs, a minor league baseball team, and the actor Bill Murray.

"One need go no further than Austin or Portland to see how food trucks have evolved into the culinary culture," Mr. Creger said. "Charleston is a little behind in that regard, but we're catching up very quickly."

Portland may be the aspirational model for many cities in the early stages of building a food cart[1] scene. But being a pioneer has its own challenges. A surge in new construction over the past couple of years has forced the closing of several food cart pods on former parking lots. Concern about the closings came to a head last fall with the news that the city's flagship food cart venue, the Alder Street pod, would be shuttered this summer to make way for the city's first five-star hotel.

"One hundred and thirty food carts are under threat to vanish," said Daniel Huerta, owner of the Portland food truck Churros Locos. "We are losing the culinary fabric that Portland is."

Street food vendors have been in big cities for decades. But a newer breed of entrepreneurs surfaced around 10 years ago as a scrappy response to the recession — it is far easier to secure start-up capital for a cart than a restaurant. Since then, it has morphed into a nationwide urban development and culinary business phenomenon. Revenue from food carts reached $2.7 billion in 2017, according to a U.S. Chamber of Commerce study.

But as the industry matures, challenges are emerging. In some areas, owners are building mini empires, adding second or third trucks as well as brick-and-mortar restaurants. But elsewhere, regulatory and market pressures are creating a tough operating environment for vendors. Oversaturation and changing culinary tastes are also concerns.

[1] Food trucks and food carts are subject to similar regulations; in this article, they are referred to interchangeably.

Source B

"Mobile Food Truck Permit and License." *City of New Orleans One Stop Permits & Licenses*, City of New Orleans, n.d., nola.gov/nola/media/One-Stop-Shop/Revenue/Food-Truck-Permit-Guide.pdf.

The following is excerpted from an informational guide published on the City of New Orleans website.

FACTS AND REGULATIONS FOR PERMITTED MOBILE FOOD TRUCKS

• **Food Truck permits and licenses expire on December 31st** and renewals are required by January 31.

• **As of January 1, 2014**, there is a **limit of 100 mobile Food Truck Permits per calendar year**. No permit shall be issued until the City receives and approves a completed application.

• There is **no proximity restriction from restaurants** for food trucks.

• Licenses and permits must be displayed and affixed to the front windshield in the lower corner on the passenger side.

• Vendors must obey all applicable parking, traffic and vehicle safety laws, regulations, and restrictions. **This includes the feeding of parking meters.**

• Trucks **can remain in one location no longer than 4 hours.**

• Trucks may only sell food; no other goods, wares, or other items may be sold.

• **Mobile food trucks may not operate:**
  - Within 20 feet of any intersection;
  - Within 20 feet of any stop sign, flashing beacon, yield sign, or other traffic control signal located on the side of a roadway;
  - Within 3 feet of any public or private driveway, wheelchair ramp or bicycle ramp;
  - In any manner that impedes an exit or entrance of an operating building.

• **No vendor may sell alcoholic beverages**, controlled substances, or any other illegal item.

• **No furniture**, or any other objects can be placed in the street, sidewalk, or any right-of-way, except a trash receptacle.

• **All vendors must provide a trash receptacle** within three feet of the front or back of the truck on a public street.

• **All vendors must keep a 50 foot radius around the truck clean** during operation and upon ceasing operation.

• **No horns, amplification systems, or other sound-producing devices or music systems** which can be heard outside of the truck may be used.

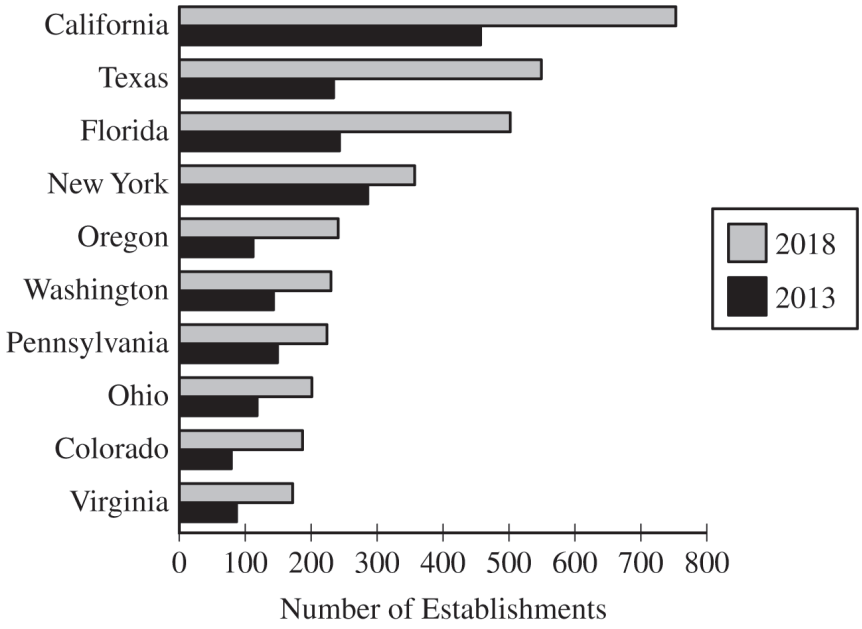
• **No third party advertising** may be displayed on any mobile food truck.

Source C

Hait, Andrew W. "Fast-Growing Food Truck Industry Can Operate Amid COVID-19 Social Distancing Rules, No Indoor Seating Orders." *United States Census Bureau*, 2 Sept. 2020, www.census.gov/library/stories/2020/09/food-trucks-one-way-to-eat-out-during-pandemic.html.

The following is adapted from a graph published by the U.S. Census Bureau.

Number of Mobile Food Services Establishments



Source D

Meehan, Sarah. "Challenges to Food-Truck Restrictions Cropping Up beyond Baltimore." *Baltimore Sun*, 26 May 2016, www.baltimoresun.com/food-drink/bs-fo-food-truck-300-foot-rule-20160526-story.html.

The following is excerpted from a newspaper article about food truck regulation in Baltimore.

The turf battle brewing in Baltimore involving the city's food trucks is one that is playing out across the country as mobile vendors fight to park where they want, when they want.

Food truck owners Nikki McGowan and Joey Vanoni teamed up this month with a national legal advocacy group to sue the city of Baltimore, contending that a rule that prohibits mobile vendors from operating within 300 feet of businesses that sell similar products is an unconstitutional, protectionist measure.

Parking restrictions on food trucks have affected entrepreneurs as close as Baltimore County and as far away as San Antonio, where a law similar to Baltimore's buffer rule was repealed last year after a challenge from the same group at work in the Baltimore case, the Institute for Justice. Closer to home, Baltimore County doesn't allow food trucks to park within 200 feet of restaurants. And the Annapolis city council is considering a bill that would expand the areas where food trucks can park but prohibit them from setting up within 100 feet of an established restaurant.

"From a national level, you're seeing a major amount of push-back toward inefficient and inconsistent issues that are holding back this industry from growing as fast as it could," said Andrew Alvarez, an industry analyst with the international market research firm IBISWorld.

Baltimore's buffer law was enacted as part of a swath of measures to regulate the burgeoning local food truck industry. And some restaurant owners support the rule that prohibits food trucks from pulling up in front of their businesses. Brian McComas, president of the Federal Hill Hospitality Association and owner of Ryleigh's Oyster, said it's not about the competition.

"I actually support food trucks from the perspective of the culinary experience and the food scene of Baltimore City," he said.

Rather, he said, it comes down to the commitment that brick-and-mortar restaurants make to the neighborhoods in which they are rooted, and the price they pay to do business there.

"I don't see anything constitutional about parking your food truck or mobile restaurant within those distances of restaurants that are there 365 days a year, paying taxes, utilities, et cetera," he said. "We've decided to be there every day of the year. We pay taxes, and unless they can tell us otherwise how that would work, why would we even want them taking a parking space?"

That's especially true in areas like Federal Hill, where bars and restaurants are concentrated and parking comes at a premium.

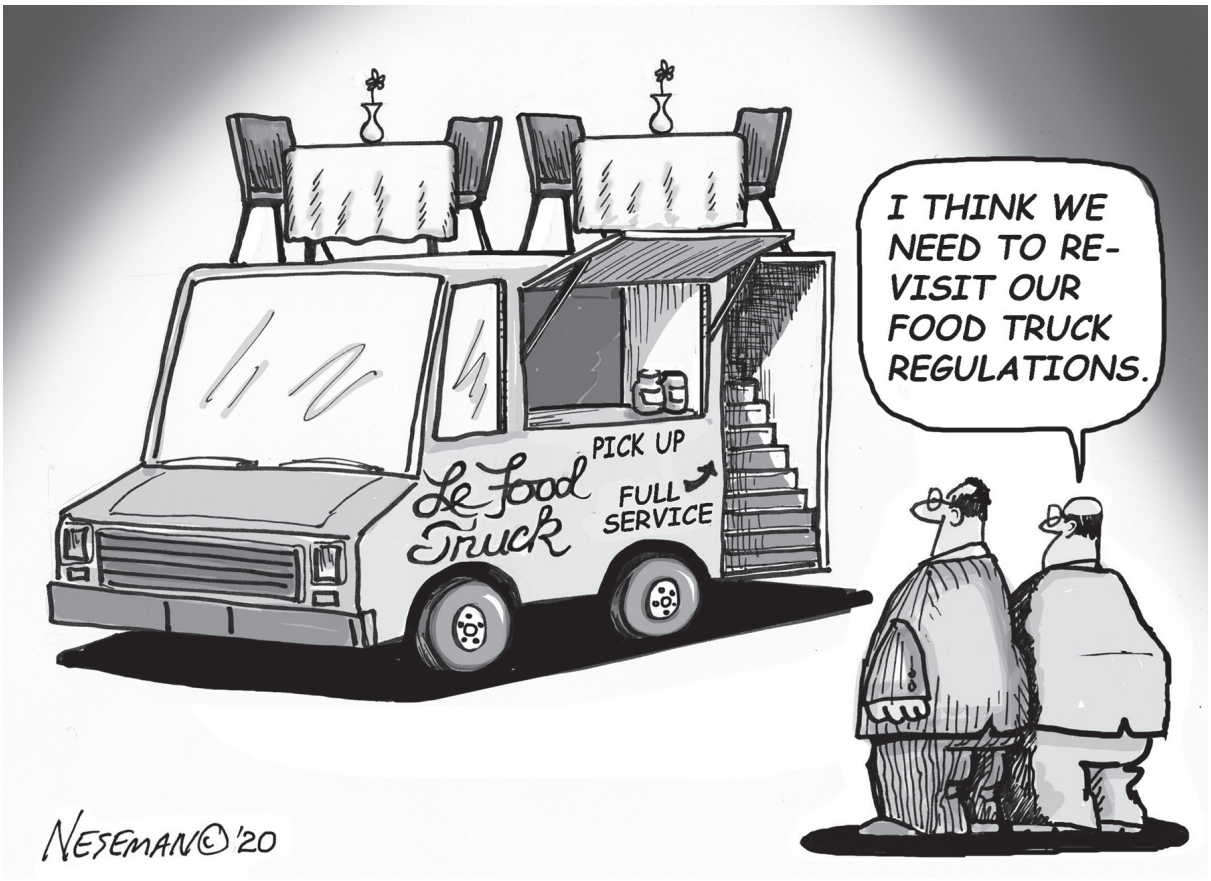
Matt Geller, founder of the National Food Truck Association, said much of the controversy surrounding food truck regulation stems from the fact that the industry is relatively young. The U.S. food truck industry is worth $857 million, according to a September 2015 report by IBISWorld, with annual growth of 9.3 percent.

"This is such a new industry, so people have these weird things they believe to be fair or unfair," said Geller, who is also CEO of the Southern California Mobile Food Vendors Association. "People don't know how to regulate it yet."

Source E

Neseman, Dale. "Full Service." *Advertiser-News South*, Strauss News, 3 Feb. 2020, www.advertisernewssouth.com/opinion/cartoons/cartoon-full-service-LK840836.

The following is an editorial cartoon that appeared in an online local newspaper.



"Full Service" by Dale Neseman, from *Advertiser-News South*. © 2020, Strauss News. Used by permission.

Source F

Weber, David. *The Food Truck Handbook: Start, Grow, and Succeed in the Mobile Food Business*. Wiley, 2012.

The following is excerpted from a book on how to start a food truck business.

The Future of Food Trucks

Food trucks are far from hitting their peak. The market is still developing, and there are many opportunities for new operators who want to open trucks to sell food that they are passionate about. Technomic, a food industry consulting firm, reported in July 2011 that 91 percent of customers polled believe that food trucks are not a passing fad, but rather a trend with "staying power." Growth in food trucks is driven by two major forces: the growth of a mobile food culture in new municipalities across the United States and the improved access to food that the trucks offer in these markets as well as established markets. Customers appreciate the value and quality of mobile food and will continue to embrace the industry so long as operators deliver clean, tasty, and interesting products at a fair price.

Food trucks are great for cities. They get customers out on the street and create a sense of community. As local municipalities learn the value of what food trucks have to offer in terms of tax revenues, job growth, tourism, activating public space, and fostering entrepreneurship, local regulations will improve. One of the most compelling aspects of food trucks is their ability to act as an incubator for entrepreneurs to start a viable, cash flow–positive business that they can grow into a brick-and-mortar establishment to become a more stable part of the community.

In addition to opportunities for food truck entrepreneurs, there is also a wide variety of opportunities in supporting industries that will develop as the food truck market matures. Food truck operators are looking for better trucks, more eco-friendly power supplies, quieter generators, small-run food manufacturers, more customizable insurance resources, more robust financing tools, marketing partners, and information technology resources.

It is an exciting time for mobile food in America. The industry is big and growing fast. I look forward to seeing what you will bring to the streets.

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.

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.)

Urban rewilding is an effort to restore natural ecological processes and habitats in city environments. Many cities around the world have embraced rewilding as part of larger movements to promote ecological conservation and environmentally friendly design. Now, a movement to promote urban rewilding is beginning to take shape in the United States as well.

Carefully read the 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 extent to which rewilding initiatives are worthwhile for urban communities to pursue.

Source A (infographic from Fastnacht)
Source B (Jepson and Schepers policy brief)
Source C (NRPA article)
Source D (Garland article)
Source E (graph from McDonald et al.)
Source F (Chatterton book excerpt)

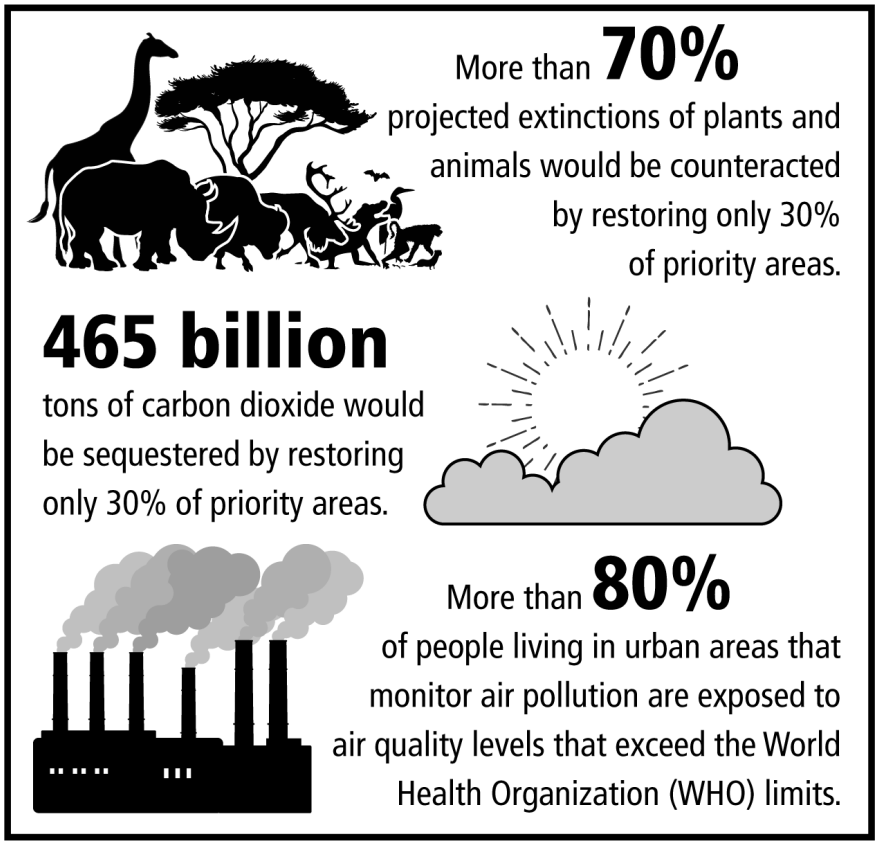
In your response you should do the following:

- 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.

Source A

Fastnacht, Sarah. "The Necessity of Rewilding our Cities." *Makers of Sustainable Spaces*, MOSS, 29 Apr. 2021, moss.amsterdam/2021/04/29/rewilding-our-cities.

The following infographic is based on an image in a blog post published by an architecture and design company that specializes in sustainability.



Note: Priority areas refers to ecosystems identified by researchers as particularly important for biodiversity. Sequestration is the capture of carbon dioxide from the atmosphere so that it does not contribute to global climate change.

Source B

Jepson, Paul, and Frans Schepers. "Making Space for Rewilding: Creating an Enabling Policy Environment." *Rewilding Europe*, Rewilding Europe, May 2016, www.rewildingeurope.com/wp-content/uploads/2016/05/Making-Space-for-Rewilding-Policy-Brief1.pdf.

The following is excerpted from a policy brief published as a collaboration between the University of Oxford and a nonprofit organization that promotes rewilding in Europe.

Rewilding is a powerful new term in conservation. This may be because it combines a sense of passion and feeling for nature with advances in ecological science. The term resonates with diverse publics and seems to have particular appeal to a younger urban generation and among those who want a voice in shaping a new rural environment. Rewilding is exciting, engaging and challenging: it is promoting debate and deliberation on what is natural and the natures we collectively wish to conserve and shape.

Rewilding is a multifaceted concept with three broad dimensions that interact with each other: 1) restoring and giving space to natural processes, 2) reconnecting wild(er) nature with the modern economy, and 3) responding to and shaping cosmopolitan perceptions of nature conservation among European society. The following principles are coming to characterise and guide rewilding as a distinct approach to conservation.

1. Restoring natural processes and ecological dynamics—both abiotic such as river flows, and biotic such as the ecological web and food-chain—through reassembling lost guilds [1] of animals in dynamic landscapes.

2. A gradated and situated approach, where the goal is to move up a scale of wildness within the constraints of what is possible, and interacting with local cultural identities.

3. Taking inspiration from the past but not replicating it. Developing new natural heritage and value that evokes the past but shapes the future.

4. Creating self-sustaining, resilient ecosystems (including re-connecting habitats and species populations within the wider landscapes) that provide resilience to external threats and pressures, including the impact of climate change (adaptation).

5. Working towards the ideal of passive management, where once restored, we step back and allow dynamic natural processes to shape conservation outcomes.

6. Creating new natural assets that connect with modern society and economy and promote innovation, enterprise and investment in and around natural areas, leading to new nature-inspired economies.

7. Reconnecting policy with popular conservation sentiment and a recognition that conservation is a culturally dynamic as well as a scientific and technical pursuit.

As a new conservation frame, rewilding brings together established and newer conservation worldviews. People are combining these in different ways creating different 'shades' of rewilding, many of which have labels. This is a limitation and opportunity. On the one hand it exposes rewilding to sensationalists media interpretations and charges of a lack of clarity, consensus and evidence by groups within conservation science. On the other

hand it reflects innovation and creates the possibility for a common, but differentiated (situated) mode of conservation: one that is guided by a set of principles that member states or regions can interpret in ways suited to their nature conservation traditions, landscapes, culture and economies.

[1] Groups of organisms that use natural resources in similar ways

Source C

"Urban Rewilding." *Parks and Recreation*, National Recreation and Park Association, 1 Nov. 2016, nrpa.org/parks-recreation-magazine/2016/november/urban-rewilding/.

The following is excerpted from an article in a magazine published by a nonprofit organization that promotes parks and environmental conservation.

"Close your eyes for a moment and picture a place from childhood that's extremely meaningful," directed Opening Session keynote speaker Dr. Scott Sampson. "Imagine what it looks like, feels like, who you're there with, what the smells are."

By an almost unanimous show of hands, Dr. Scott, host and science advisor of the Emmy-nominated PBS KIDS television series "Dinosaur Train" and author of *How to Raise a Wild Child: The Art and Science of Falling in Love with Nature*, illustrated how, for a large number in the audience, that extremely meaningful childhood place involves the outdoors. The audience largely consisted of Baby Boomers/Generation Xers who remember enjoying abundant, unstructured outdoor playtime as kids. For many of today's youth, those childhood places will look much different.…

Imagine 25 years from now, he posits, how many hands would be raised in response to the same question about a meaningful childhood place involving the outdoors. "If people don't spend any time outside, why are they going to care about their local places let alone the national parks in the distance," he asked.

Dr. Scott suggests that "urban rewilding" in our cities and towns is what's needed to head off this crisis. Rewilding is a term usually used in connection with reintroducing an apex predator into an ecosystem in an attempt to restore balance. A familiar example of this top-down approach to restoring balance would be the efforts to return wolves to Yellowstone Park. Urban rewilding is a bottom up approach that starts with the simple act of planting mostly native plants. They are critical to attracting native insects, which in turn attract birds and various animals back to the local ecosystem. And, if we do urban rewilding right, cities could become places where nature is welcome. And once that happens, we need to help children develop **NEW** eyes to see nature: to **n**otice it, **e**ngage with it—play is an important way for kids to engage with nature and it also allows them to gain some experience with risk-taking, while developing a sense of **w**onder about it.

This movement to "rewild" or "wild" children touches on all three NRPA Pillars—Conservation, Health and Wellness and Social Equity. However, it's a movement that requires big thinking about what we want the future to look like and for each community that future will look different. It also will require deep collaboration among multiple organizations that bring their various areas of expertise, each doing their part to achieve the end goal of successful, thriving communities. "We're at a juncture where the decisions we and the next generation make will determine the course of this planet for thousands of years to come," Dr. Scott noted. He then challenged us to go out into our communities and think about what those collaborations could be, look like and grow into, and to think big because "that's where success resides."

Source D

Garland, Lincoln. "Let Go of Some Urban Domestication: How Would You Convince the Mayor to Re-wild the City?" *The Nature of Cities*, The Nature of Cities, www.thenatureofcities.com/2017/11/13/re-wilding-make-cities-better-just-wilder/.

The following is excerpted from an online discussion of urban rewilding in the United Kingdom hosted by a nonprofit organization that publishes research and writing about cities. The author is the associate director of an environmental consultancy.

There are certainly opportunities for introducing re-wilding in rural parts of the UK, in particular in upland regions where, without subsidy, agriculture is economically unviable for the most part. With respect to the UK's cities, nature should also be allowed to take its own path in certain select locations to create some semblance of wildness. I am unconvinced however that re-wilding is the appropriate terminology or the approach to wildlife restoration that we should be pursuing in UK cities at any meaningful scale.

The large expanses of greenspace that would be required to recreate fully functioning *wildwood*, including relatively large numbers of herbivores and viable populations of naturally scarce predators at the top of food chain, are simply not available in our cities, where space is increasingly at a premium. Sustainable urban design should be seeking to avoid low-density sprawl and instead promote compact, transit-oriented, pedestrian-and-bicycle friendly urban development that provides easy access to services. This development model is crucial for tackling congestion and for reducing CO2 and other harmful emissions. Given this compact city imperative, the proposition of devoting large areas of urban space for re-wilding in anything approaching its true sense is untenable.…

Some authors/practitioners respond that there should be no minimum area thresholds for wilderness and re-wilding from an ecological perspective, frequently quoting Aldo Leopold who declared that *"no tract of land is too small for the wilderness idea"*. While it is true that ecosystems can be considered at the microcosm, there really is not the space available to recreate complex self-sustaining food webs, with meaningful ranges of predators and prey, in accordance with the true principles of re-wilding.

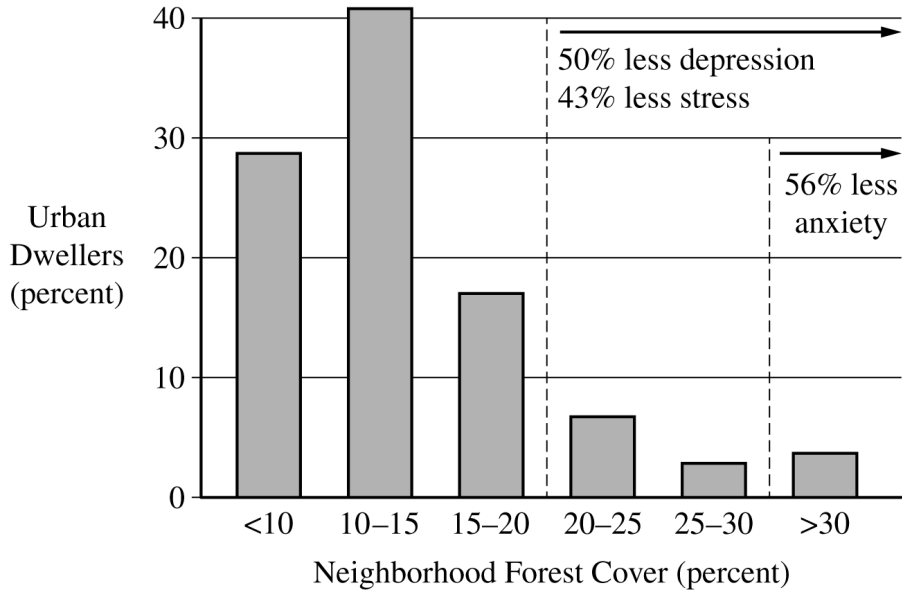
Even ignoring the seeming disregard for matters relating to population viability analysis and the principles of island biogeography, other concerns remain. In those small areas where nature can be left to its own devices, many people may have a profound dislike for the outcome that sometimes emerges. Negative comments may be expressed relating to perceptions of safety, the appearance of neglect, reduced accessibility and visual/aesthetic preference. With respect to the last of these concerns, while education programmes can attune people's valuation patterns, within an urban context a great many people will continue to favour more ordered, manicured environments. Undeniably, a previously accessible urban greenspace that has been left to nature, which then rapidly succeeds into a monoculture of impenetrable bramble or butterfly-bush, is unlikely to be well-received by most local residents.…

The disturbed nature of urban soils is likely to be another major limiting factor, impoverished as they frequently are in terms of seedbank, organic material and soil organisms. Without active management newly emerging urban woodland would also be subject to degradation by trampling, visual and noise disturbance, fire, invasive species, effects of predatory pets etc. To reiterate, unencumbered natural succession may well produce landscapes in urban areas dramatically less visually and ecologically appealing than anticipated.

Source E

McDonald, Robert Ian, et al. "The Green Soul of the Concrete Jungle: The Urban Century, the Urban Psychological Penalty, and the Role of Nature." *Sustainable Earth,* vol. 1, no. 3, 2018, sustainableearth.biomedcentral.com/articles/10.1186/s42055-018-0002-5.

The following is based on a graph published in a community-focused academic journal dedicated to advancing environmental sustainability. It shows responses from a survey conducted in three towns in the United Kingdom.



Forest cover in urban neighborhoods and its impact on mental health. The bar chart shows the fraction of urban dwellers who live in neighborhoods with varying levels of forest cover.

Source F

Chatterton, Paul. *Unlocking Sustainable Cities: A Manifesto for Real Change*. Pluto Press, 2019.

The following is an excerpt from a book exploring the benefits of urban rewilding.

We are beginning to see a proliferation of hybrid natural and built forms through, for example, living walls, rooftop farms, vertical or sky gardens and breathing buildings. These can have significant beneficial effects. For example, urban street canyons refer to the effect created by high buildings lining a street, which can become hotspots for harmful pollutants, such as nitrogen dioxide and particulate matter. A study by Thomas Pugh and colleagues from the Lancaster Environment Centre suggests that strategic placement of vegetation in street canyons can cut air pollution by up to 30 per cent. They can also stop urban overheating and provide effective insulation and shading for buildings, as well as reducing noise pollution. And of course, there are the psychological and aesthetic benefits of being proximate to an abundance of natural greenery.

Green corridors and linear parks can be retrofitted into the existing city. For example, the High Line project in New York transformed an old rail line into a nearly two-mile urban park. It opened in 2014 and became a short cut for walkers and one of the city's favourite parks featuring art installations and places for hanging out. Other cities are following suit including Chicago's 606 Park and Toronto's Bentway, which has slotted 55 outdoor rooms under its Gardiner Expressway featuring farmers' markets, performance spaces and a children's garden. Miami is also building the Underline, a nine-mile linear park underneath its metrorail line. In my own city of Leeds, a community group is attempting to do the same thing on one of Leeds' abandoned Victorian train viaducts. The Madrid Rio project was one of the most exciting urban reclamation projects in Europe—burying a former ring road to create over 600 hectares of parkland. Efforts are being made not just to create greenspaces, but to create interconnected green corridors. For example, the All London Green Grid (ALGG) is the green infrastructure strategy for London, which sets out a vision to create an interconnected network of green and blue spaces across the entire city. It is this interconnection that is so important in terms of creating space for biodiversity to move more extensively.

Singapore is one of the pioneers of placing nature at the heart of its planning and urban design process. As a self-labelled garden city, it now prefers to call itself 'the city in a garden'. To realize this vision of living in an urban park, Singapore implemented a landscape replacement policy whereby any greenery removed during construction has to be reinstated as part of the development. It is estimated that the amount of urban greenery has been at least doubled, but mainly through sky gardens. The city has also built nearly 300km of park connectors to create deeper connections between parks and neighbourhoods.

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.

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.

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

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.

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.

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

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.

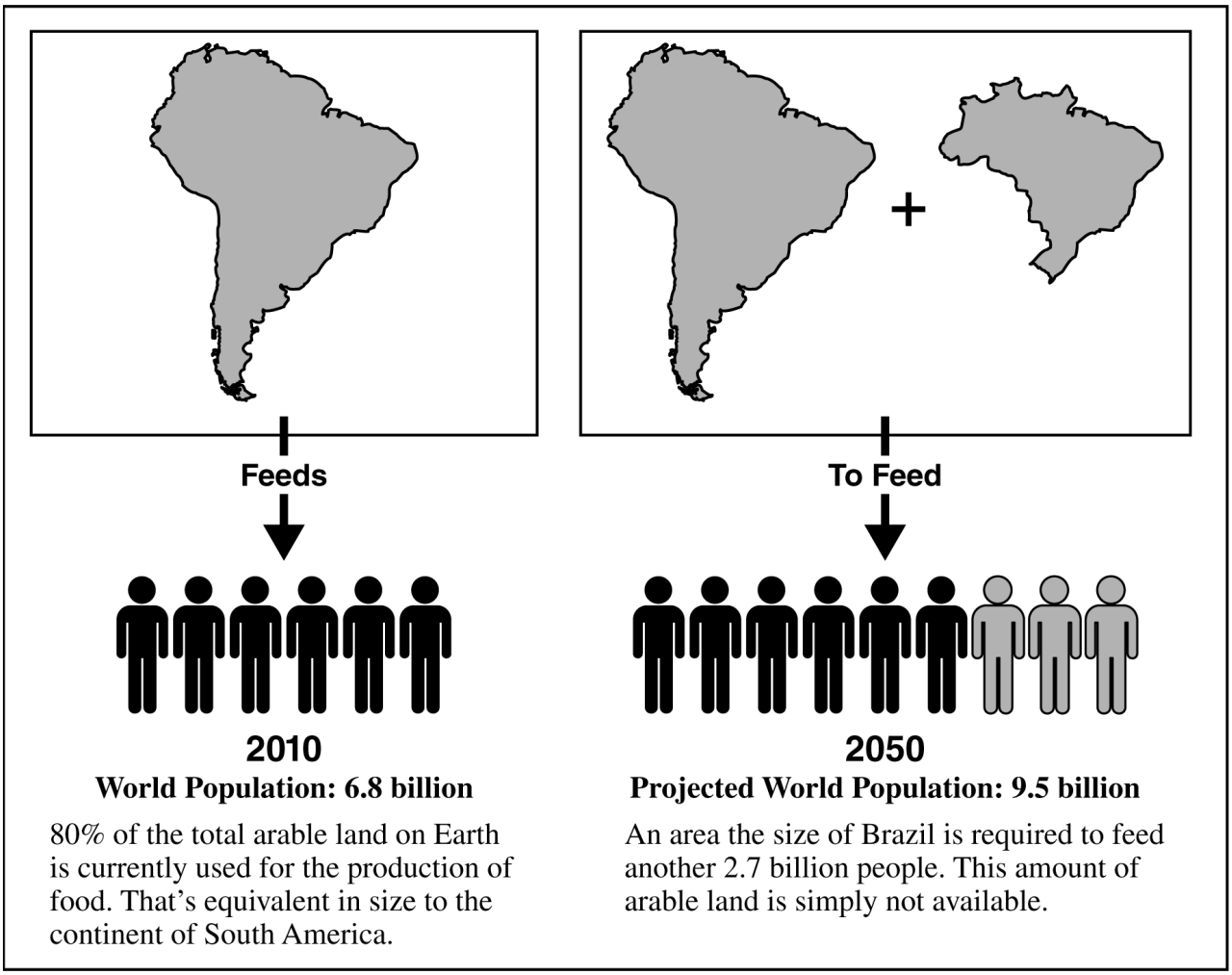
[1] suitable for growing crops

[2] living plant tissue used to generate other plants

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.