

SAT Reading Passage Strategies

LEARNING OBJECTIVES

After completing this chapter, you will be able to:

- Identify keywords that promote active reading and relate passage text to the questions
- Create short, accurate margin notes that help you research the text efficiently
- Summarize the big picture of the passage

How Much Do You Know?

Directions: In this chapter, you'll learn how SAT experts actively read the passage, take notes, and summarize the main idea to prepare themselves to answer all of the passage's questions quickly and confidently. You saw this kind of reading modeled in the previous chapter. To get ready for the current chapter, take five minutes to actively read the following passage by 1) noting the keywords that indicate the author's point of view and the passage's structure, 2) jotting down a quick description next to each paragraph, and 3) summarizing the big picture (the passage's main idea and the author's purpose for writing it). When you're done, compare your work to the passage notes that follow.

This passage is adapted from a 2018 article summarizing two different proposals for solving problems with maintaining New York City's mass transit system.

The history of the New York City subway system, quickly told: the first stations opened in 1904, and over the next century, it expanded to 472 stations, more than any other subway system in the world, with 850 miles of track. Operating 24 hours a day seven days a week, with an average weekday ridership of approximately 5.7 million, it is the planet's 7th-busiest rapid transit system. While the system is, on many levels, an amazing achievement, it is also beset by a problem that harms both quality of life and economic activity. Such a large system must inevitably suffer from service interruptions and delays; normal wear and tear combined with the sheer age of the system necessitates regular maintenance. However, there is no consensus as to the best way to accomplish the required repairs.

The current maintenance scheme is designed to minimize service interruptions. A subway line in need of repair will be taken out of service during a comparatively less busy time, such as nights or weekends, while another line is re-routed to cover as many as possible of the missing line's stops. The main advantage to this approach is that trains are not taken out of service during rush hour, when most subway trips occur; subway

service generally remains predictable and commuters are, for the most part, able to use the system to get to their destinations on time.

But critics are quick to point out the disadvantages to this approach. Perhaps most obvious is the confusion caused by trains switching lines. The labyrinthine system is hard enough to navigate at the best of times, especially for tourists. A subway rider on the A train naturally expects the train to make stops on the A line. If, instead, it is diverted temporarily to the F line, the rider may find herself miles from her intended destination.

While annoying, the confusion arising from route switching is hardly the most serious problem with the current approach to repairs. Because the system runs 24 hours a day, routine maintenance can generally be done only during the temporary closures on nights and weekends. This means that more serious repair and crucial preventative maintenance is often neglected. Problems that could have been fixed or prevented reasonably expeditiously given a slightly longer closure wind up leading to major breakdowns and service interruptions later on.

On rare occasions, such breakdowns have resulted in entire subway lines being shut down for months or even a year. Beginning in 2019, for example, the L Train connecting lower

Manhattan to parts of Brooklyn was scheduled to close for as much as 15 months for long overdue service and upgrades. In a city fewer than half
 75 of whose households own a car, this can have serious economic impacts. Residents of the affected area may face a much longer commute via an alternate subway line if one is available;
 80 or, if there is no alternate subway service, they may need to take other, potentially more expensive, modes of transportation, such as taxis or ferries. Moreover, studies indicate that
 85 increased stress from the commute to work can lead to lower productivity, and that businesses near the impacted lines may see decreased revenue as potential customers have a harder time getting to
 90 them.

One controversial proposal for reducing breakdowns and the resulting transit interruptions is to end the subway's 24-hour service and to shut
 95 down for several hours each night. Proponents of this plan argue that this would allow time, on a regular rather than sporadic basis, for more preventative maintenance. This, they
 100 claim, would ultimately lead to more consistent service; rather than shutting down entire lines for long periods of a time, there would merely be shorter service outages overnight, when fewer
 105 people use the subway system. While this may seem a preferable outcome to the economic consequences of a total shutdown resulting from a breakdown, it has its liabilities as well. While most
 110 subway trips may occur during rush hour, not everyone works during the daytime. New York is famously known as the "the city that never sleeps." Doctors, nurses, bartenders, police
 115 officers, and firefighters are just a few examples of occupations whose workers

need transportation at all hours of the day and night. Rather than be subjected to a relatively short period
 120 of inconvenience, these workers would find their commutes irrevocably altered. One thing, at least, is clear: the city must carefully consider many economic and social factors in designing a subway
 125 maintenance plan.

Check Your Work

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The current maintenance scheme is designed to minimize service interruptions. A subway line in need of repair will be taken out of service during a comparatively less busy time, such as nights or weekends, while another line is re-routed to cover as many as possible of the missing line's stops. The main advantage to this approach is that trains are not taken out of service during rush hour, when most subway trips occur; subway service generally remains predictable and commuters are, for the most part, able to use the system to get to their destinations on time.

But critics are quick to point out the disadvantages to this approach. Perhaps

NYC
subway:
how to
repair?
diff. views

Current
approach -
night and
weekend
repairs

Critics:
line switch
confusion

ANALYSIS

Pre-passage blurb: This tells you that the topic of the passage is a debate over the New York City subway system. Expect to see at least two sides in the debate. Note where each different position is discussed.

SAT Reading Strategy: On the SAT, the blurb almost always contains the title of the book or article from which the passage was adapted. Sometimes the test maker will provide additional context as well. Always take advantage of it.

¶1: The author introduces the New York City subway system by highlighting its age and size. Those two factors are the reason maintenance is such a big issue. The scope of the passage comes at the end of the paragraph: there is no agreement on *how* best to perform upkeep on the massive system.

¶2: This paragraph outlines the current maintenance schedule. Repairs happen mostly on nights and weekends. The main advantage is that subway lines are not down during rush hours.

¶3: Here comes the opposing view. One disadvantage of the current system is that trains are rerouted, causing confusion for riders.

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trains switching lines. The labyrinthine
system is hard enough to navigate at the
best of times, especially for tourists. A
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Because the system runs 24 hours a
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- major
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75 of whose households own a car, this
can have serious economic impacts.
Residents of the affected area may
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alternate subway line if one is available;
80 or, if there is no alternate subway
service, they may need to take other,
potentially more expensive, modes
of transportation, such as taxis or
ferries. Moreover, studies indicate that
85 increased stress from the commute to

Econ. & Soc.
harms of
shutdowns

¶14: A second, worse problem with the current system is that it doesn't allow enough time for preventative maintenance. That leads to big problems down the line.

¶15: These big problems can shut down subway lines for weeks or months causing grave economic impact to affected riders and businesses.

work can lead to lower productivity, and that businesses near the impacted lines may see decreased revenue as potential customers have a harder time getting to them.

One controversial proposal for reducing breakdowns and the resulting transit interruptions is to end the subway's 24-hour service and to shut down for several hours each night.

Proponents of this plan argue that this would allow time, on a regular rather than sporadic basis, for more preventative maintenance. This, they claim, would ultimately lead to more consistent service; rather than shutting down entire lines for long periods of a time, there would merely be shorter service outages overnight, when fewer people use the subway system. While this may seem a preferable outcome to the economic consequences of a total shutdown resulting from a breakdown, it has its liabilities as well. While most

subway trips may occur during rush hour, not everyone works during the daytime. New York is famously known as the "the city that never sleeps." Doctors, nurses, bartenders, police officers, and firefighters are just a few examples of occupations whose workers need transportation at all hours of the day and night. Rather than be subjected to a relatively short period of inconvenience, these workers would find their commutes irrevocably altered.

One thing, at least, is clear: the city must carefully consider many economic and social factors in designing a subway maintenance plan.

Alt proposal
- stop
24-hour
service

Pros

Cons

¶16: This paragraph opens with a controversial proposal: stop running the subway 24/7. While this would make more time for preventative maintenance, it too has a big disadvantage: many workers need to commute overnight. The author's conclusion is neutral: New York City has to weigh both sides to make the best decision.

BIG PICTURE

Main Idea: New York City must weigh different economic and social factors to design an effective subway maintenance plan.

Author's Purpose: To explain advantages and disadvantages in opposing views of how best to maintain the New York City subway

SAT Reading Strategies—Keywords, Margin Notes, and the Big Picture Summary

LEARNING OBJECTIVES

After this lesson, you will be able to:

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- Create short, accurate margin notes that help you research the text efficiently
- Summarize the big picture of the passage

To read and map a passage like this:

This passage was adapted from an article titled “Millennials and the Market,” written by a money management expert in 2018.

During the Golden Age of American manufacturing, it was expected that after putting in 30 to 40 years of tedious labor in a factory, workers would be able to retire around age 65 and enjoy the benefits of retirement comforted by the thought that a pension and the Social Security system they had financed for decades would cover their expenses. Unfortunately for millennials (people born between the early 1980s and late 1990s), prospects look increasingly bleak that they will get a return on their investment at retirement age, despite continuing to fund programs like Social Security and Medicare. Fewer than a quarter of all Fortune 500 corporations still offer some form of pension plan to new hires, and the move from company-funded pension plans to 401(k) plans and IRAs that began in the 1970s shows no sign of slackening. In this financial environment, it might be expected that investment in the stock market would be at an all-time high. An analysis of the data, however, indicates a complicated and even fraught relationship between young adults and the stock market.

The trauma associated with the Great Recession (which began in December 2007 and ended in June 2009) left many investors wary of stock market volatility, and that hesitancy was exacerbated among young people, who saw a considerable portion of their families’ wealth erased in short order. A study by Pfeffer, Danziger, and Schoeni published in 2014 posited that the average American household

lost a third of its wealth, approximately \$28,000, during the Great Recession.

This was at the exact moment when a great many millennials were making decisions about attending college, pursuing post-graduate studies, or entering the workforce. For a median-income family, those decisions were all directly correlated to household wealth. The ripple effects of the Great Recession left many millennials ascribing blame directly to the stock market for missed opportunities. Even with a full awareness that the stock market has rebounded and far exceeded the highs seen prior to the Great Recession, many millennials still feel trepidation about investing in the stock market, preferring to save a larger percentage of their salaries than their parents and grandparents did.

Another factor that has directly impacted the willingness of millennials to invest in the stock market is the seismic shift in the job market brought about by the “gig economy,” in which short-term contracts and freelance work have replaced permanent employment. To a large degree, the gig economy is still in its nascent phase, with many of the largest purveyors of jobs only incorporated in the last decade. Research has not adequately kept track of the trend, with estimates of participation in the gig economy ranging from 4% to 40% in the United States. The ability to pick up work on a contingency basis allows millennials to feel a greater level of control over their finances, something a significant number of them believe they cannot achieve through stock market investment. The increased diversity of available methods for

building future wealth has caused many millennials to adopt an a la carte approach to preparing for retirement.

But is it possible that this approach has been clouded by some common misconceptions about wealth building?

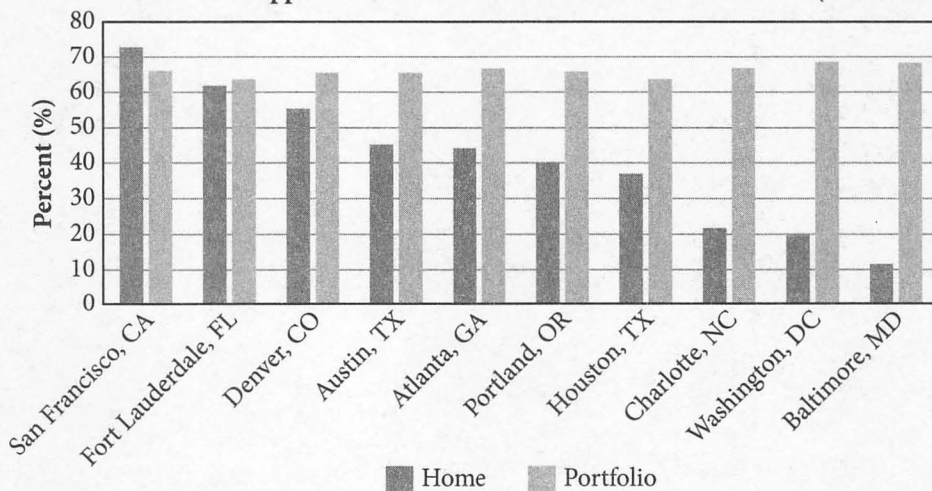
One persistent, albeit erroneous, view is that real estate is a better investment instrument than a stock market portfolio. While it is true that home equity is the stepping-stone from which most individuals begin to build their personal wealth, statistics make it clear that stock market investments are a more stable and lucrative source of long-term wealth. A London Business School study found that over the same 90-year period, the average rate of return on a real estate investment was 1.3% compared to the 9.8% annualized total return for the S&P stock 500 index. Investing the \$5,500 IRS-imposed annual limit in an IRA for 25 years would result in a return of over \$600,000 based on the annualized return rate. Stock investment requires a smaller overhead than real estate investment, and the liquid nature of stocks makes them ideal for retirement: stocks allocated to retirement accounts

115 remain tax-free until they are drawn on. Despite these pieces of tangible evidence, though, the stigma regarding stock market investment persists in the minds of many millennials.

120 Regardless of their feelings about the stock market, one thing is self-evident: without preparation for retirement, millennials will be a generation adrift in a society without the social “safety nets” available to current retirees.

125 The benchmark for the amount of savings the average retiree needs to live comfortably after retirement, which remained at \$1 million for many years, now continues to rise, and exacerbating factors, such as the cost of medical care, continue to increase. Armed with that knowledge, millennials need to be proactive about financial planning. By taking full advantage of their penchant for a hands-on approach to finances and leveraging the various financial technologies and services that were not available to the previous generation, 135 millennials can amass the wealth necessary to retire comfortably and on their own terms.

Median Home Appreciation & Median Financial Portfolio Return (2010–2018)



You need to know this:

- SAT Reading passages are preceded by short blurbs that tell you about the author and source of the passage.
- There are three categories of keywords that reveal an author's purpose and point of view and that unlock the passage's structure:
 - **Opinion and Emphasis**—words that signal that the author finds a detail noteworthy (e.g., *especially, crucial, important, above all*) or has an opinion about it (e.g., *fortunately, disappointing, I suggest, it seems likely*)
 - **Connection and Contrast**—words that suggest that a subsequent detail continues the same point (e.g., *moreover, in addition, also, further*) or that indicate a change in direction or point of difference (e.g., *but, yet, despite, on the other hand*)
 - In some passages, these keywords may show steps in a process or developments over time (e.g., *traditionally, in the past, recently, today, first, second, finally, earlier, since*)
 - **Evidence and Example**—words that indicate an argument (the use of evidence to support a conclusion), either the author's or someone else's (e.g., *thus, therefore, because*), or that introduce an example to clarify or support another point (e.g., *for example, this shows, to illustrate*)

You need to do this:

- Extract everything you can from the pre-passage blurb.
- Read each paragraph actively; outline the passage as you read.
- Summarize the passage's big picture.



Extract everything you can from the pre-passage blurb

- Quickly prepare for the passage by unpacking the pre-passage blurb:
 - What does the title and date of the original book or article tell you about the author and her purpose for writing?
 - What information can you glean from the source (nonfiction book, novel, academic journal, etc.)?
 - Is there any other information that provides context for the passage?

Read each paragraph actively

- Note keywords (circling or underlining them may help) and use them to focus your reading on the following:
 - The author's purpose and point of view
 - The relationships between ideas
 - The illustrations or other support provided for passage claims

KEYWORDS

Why pay attention to keywords?

Keywords indicate opinions and signal structure that make the difference between correct and incorrect answers on SAT questions. Consider this question:

With which one of the following statements would the author most likely agree?

1. Coffee beans that grow at high altitudes typically produce dark, mellow coffee when brewed.
2. Coffee beans that grow at high altitudes typically produce light, acidic coffee when brewed.

To answer that based on an SAT passage, you will need to know whether the author said:

Type X coffee beans grow at very high altitudes *and so* produce a dark, mellow coffee when brewed.

That would make choice (1) correct. But if the author instead said:

Type X coffee beans grow at very high altitudes *but* produce a *surprisingly* dark, mellow coffee when brewed.

Then choice (2) would be correct. The facts in the statements did not change at all, but the correct answer to the SAT question would be different in each case because of the keywords the author chose to include.

- As you read, jot down brief, accurate margin notes that will help you research questions about specific details, examples, and paragraphs:
 - Paraphrase the text (put it into your own words) as you go.
 - Ask “What’s the author’s point and purpose?” for each paragraph.

Summarize the passage’s big picture

- At the end of the passage, pause for a few seconds to summarize the passage’s big picture. Doing so will help you understand the passage as a whole and will help you prepare for Global questions. Ask yourself:
 - What is the main idea of the entire passage? (If the author had only a few seconds to state what she thinks is most important, what would she say?)
 - Why did the author write it? (State the purpose as a verb, e.g., to *explain*, to *explore*, to *argue*, to *rebut*, etc.)

Explanation:

This passage was adapted from an article titled “Millennials and the Market,” written by a money management expert in 2018.

During the Golden Age of American manufacturing, it was expected that after putting in 30 to 40 years of tedious labor in a factory, workers would be able to retire around age 65 and enjoy the benefits of retirement comforted by the thought that a pension and the Social Security system they had financed for decades would cover their expenses. Unfortunately for millennials (people born between the early 1980s and late 1990s), prospects look increasingly bleak that they will get a return on their investment at retirement age, despite continuing to fund programs like Social Security and Medicare. Fewer than a quarter of all Fortune 500 corporations still offer some form of pension plan to new hires, and the move from company-funded pension plans to 401(k) plans and IRAs that began in the 1970s shows no sign of slackening. In this financial environment, it might be expected that investment in the stock market would be at an all-time high. An analysis of the data, however, indicates a complicated and even fraught relationship between young adults and the stock market.

Millennials won't have same re-tirement \$

But they don't like stock market

ANALYSIS

Pre-passage blurb: This passage discusses millennials and the stock market. It is written from the perspective of an investment counselor.

SAT Reading Strategy: On the SAT, the pre-passage blurb will always give the author’s name, the title of the book or article from which the passage was adapted, and the year it was published. When necessary, the blurb may also include a context-setting sentence with additional information. Train yourself to unpack the blurb to better anticipate what the passage will cover.

¶1: The first opinion keyword is “[u]nfortunately” (line 10). The author explains that, when they retire, millennials will not have the same kinds of pensions and social “safety net” programs that their parents and grandparents had. Then, the author expresses surprise that despite these challenges, millennials are hesitant to invest in the stock market.

SAT Reading Strategy: When an author introduces a surprising or confusing event or condition, expect her to offer some explanation in the following paragraph(s).

The trauma associated with the Great Recession (which began in December 2007 and ended in June 2009) left many investors wary of stock market volatility, and that hesitancy was exacerbated among young people, who saw a considerable portion of their families' wealth erased in short order. A study by Pfeffer, Danziger, and Schoeni published in 2014 posited that the average American household lost a third of its wealth, approximately \$28,000, during the Great Recession. This was at the exact moment when a great many millennials were making decisions about attending college, pursuing post-graduate studies, or entering the workforce. For a median-income family, those decisions were all directly correlated to household wealth. The ripple effects of the Great Recession left many millennials ascribing blame directly to the stock market for missed opportunities. Even with a full awareness that the stock market has rebounded and far exceeded the highs seen prior to the Great Recession, many millennials still feel trepidation about investing in the stock market, preferring to save a larger percentage of their salaries than their parents and grandparents did.

Another factor that has directly impacted the willingness of millennials to invest in the stock market is the seismic shift in the job market brought about by the "gig economy," in which short-term contracts and freelance work have replaced permanent employment. To a large degree, the gig economy is still in its nascent phase, with many of the largest purveyors of jobs only incorporated in the last decade. Research has not adequately kept track of the trend, with estimates of participation in the gig economy

Reason:
07-09
recession =
millennials
blame the
market

¶12: One reason millennials distrust the stock market is that many came of age during the Great Recession. They saw their families' savings wiped out and, right out of high school, they had to make tough decisions about going to college or getting a job.

¶13: A second reason millennials avoid stock market investing is the rise of the "gig economy," in which many people have short-term, freelance jobs. This makes millennials open to different ways of managing their money, but maybe they have a mistaken viewpoint.

SAT Reading Strategy: When the author poses a question, expect her to answer it in the following sentence or paragraph.

Reason 2:
gig economy
= diff. ways
to make \$

ranging from 4% to 40% in the United States. The ability to pick up work on a contingency basis allows millennials to feel a greater level of control over their finances, something a significant number of them believe they cannot achieve through stock market investment. The increased diversity of available methods for building future wealth has caused many millennials to adopt an a la carte approach to preparing for retirement.

80
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90 But is it possible that this approach has been clouded by some common misconceptions about wealth building?

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120 Regardless of their feelings about the stockmarket, one thing is self-evident: without preparation for retirement,

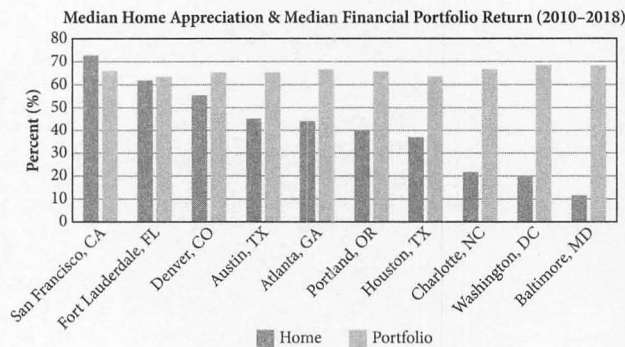
Bad thinking: house > stock mkt

¶14: One mistake millennials make comes from thinking that owning a home is a better investment than the stock market. Studies show that this isn't true. There are also tax advantages to investing in stocks for retirement.

¶15: Feelings aside, millennials will need investment to have a retirement income. Money for retirement will get tighter, but if millennials use a variety of investments, they can get the wealth they need.

millennials will be a generation adrift in a society without the social “safety nets” available to current retirees. The benchmark for the amount of savings the average retiree needs to live comfortably after retirement, which remained at \$1 million for many years, now continues to rise, and exacerbating factors, such as the cost of medical care, continue to increase. Armed with that knowledge, millennials need to be proactive about financial planning. By taking full advantage of their penchant for a hands-on approach to finances and leveraging the various financial technologies and services that were not available to the previous generation, millennials can amass the wealth necessary to retire comfortably and on their own terms.

Millennials need to adapt their thinking to have retirement \$



Graphic: The graph shows return on investment for homes and for stock portfolios in 10 cities during the 2010s. This relates back to paragraph 4. The graph shows that stocks outperformed home ownership (sometimes by a lot) in 9 of the 10 cities.

SAT Reading Strategy: When an SAT Reading passage is accompanied by one or more charts or graphs, ask the following questions as you read them:

- What information does the graphic contain?
- Why has the author included the graphic?
- Which paragraph(s) does this information relate to?
- Does the graphic display any trends or relationships that support a point made in the passage?

In the Reading section, you will not be asked to perform calculations from the data in graphs. You will be asked how they relate to the passage and which claims or arguments they support or refute.

BIG PICTURE

Main Idea: Millennials are skeptical of investing in the stock market for multiple reasons but will need a variety of investments to be financially secure at retirement.

Author’s Purpose: To outline challenges facing millennials in investing for retirement and explain why they are hesitant to invest in the stock market

Now, try another passage on your own. Use the SAT Reading strategies and tactics you’ve been learning to read and map this passage as quickly and accurately as you can.

Try on Your Own

Directions: Actively read and map the following passage by 1) circling or underlining keywords (from the Opinion and Emphasis, Connection and Contrast, or Evidence and Example categories); 2) jotting down brief, accurate margin notes that reflect good paraphrases of each paragraph; and 3) summing up the big picture. When you're done, compare your work to that of an SAT expert in the Expert Responses section.

This passage was adapted from an article titled "Quantum Computing: Where Is It Going?" published in a science magazine in 2018. It discusses the background and potential of quantum computing.

Pharmaceutical companies dream of a time when their research and development process shifts from looking for illnesses whose symptoms can be ameliorated by a specific drug to choosing a disease and creating a drug to eradicate it. Quantum computing may be the key to that goal. The powerful modeling potential unlocked by quantum computing may also someday be employed by autonomous vehicles to create a world free of traffic jams. With plausible applications in so many fields, it is worthwhile to learn a bit about how quantum computing works.

Any understanding of quantum computing begins with its most basic element, the qubit. In classical computing, information is processed by the bit, the binary choice of zero or one. Qubits, on the other hand, allow for infinite superpositions between zero and one and thus can store and process exponentially more complicated values. Imagine showing someone where you live on a globe by pointing only to either the North Pole or the South Pole. While you are likely closer to one pole than the other, you need additional information to represent your specific location. If, however, you could provide your home's latitude and longitude, it could be located without any additional information. The power of quantum

computing lies in the ability to express precise information in a single qubit.

Quantum computing may help scientists and engineers overcome another barrier by reducing energy output while increasing computational speed. The positive correlation between energy output and processing speed often causes classical computers to "run hot" while processing overwhelming amounts of data. Along with their ability to store multiple values simultaneously, qubits are able to process those values in parallel instead of serially. How does processing in parallel conserve energy? Suppose you want to set the time on five separate alarm clocks spaced ten feet apart. You'd have to walk to each clock to change its time. However, if the clocks were connected such that changing the time on one immediately adjusted the other four, you would expend less energy and increase processing speed. Therein lies the benefit of the quantum entanglement of qubits.

While quantum computing has moved beyond the realm of the theoretical, significant barriers still stand in the way of its practical application. One barrier is the difficulty of confirming the results of quantum calculations. If quantum computing is used to solve problems that are impossible to solve with classical computing, is there a way to "check" the results? Scientists hope this paradox may soon be resolved. As a graduate student, Urmila Mahadev devoted over a decade to creating a verification

process for quantum computing.

The result is an interactive protocol, based on a type of cryptography called

80 Learning With Errors (LWE), that is similar to “blind computing” used in cloud-computing to mask data while still performing calculations. Given current limitations, Mahadev’s protocol
85 remains purely theoretical, but rapid progress in quantum computing combined with further refinement of the protocol will likely result in real-world implementation within the next
90 decade or two.

It is unlikely that early pioneers in the field, including Stephen Wiesner, Richard Feynman, and Paul Benioff, could have foreseen the rapid progress
95 that has been made to date. In 1960, when Wiesner first developed conjugate coding with the goal of improving cryptography, his paper on the subject was rejected for publication
100 because it contained logic far ahead of its time. Feynman proposed a basic quantum computing model at the 1981 First Conference on the Physics of Computation. At that same conference,
105 Benioff spoke on the ability of discrete mechanical processes to erase their own history and their application to Turing machines, a natural extension of Wiesner’s earlier work. A year later,
110 Benioff more clearly outlined the theoretical framework of a quantum computer.

The dawn of the 21st century brought advancements at an even
115 more impressive pace. The first 5- and 7-qubit nuclear magnetic resonance (NMR) computers were demonstrated in Munich, Germany, and Santa Fe, New Mexico, respectively. In 2006,
120 researchers at Oxford were able to cage a qubit within a “buckyball,” a buckminsterfullerene molecule, and

maintain its state for a short time using precise, repeated microwave pulses. The

125 first company dedicated to quantum computing software, IQB Information Technologies, was founded in 2012, and in 2018, Google announced the development of the 72-qubit Bristlecone
130 chip designed to prove “quantum supremacy,” the ability of quantum computers to solve problems beyond the reach of classical computing.

With progress in quantum
135 computing accelerating, it seems inevitable that within a few decades, the general population will be as familiar with quantum computing as they now are with classical computing. At present,
140 quantum computing is limited by the struggle to build a computer large enough to prove quantum supremacy, and the costs associated with quantum computing are prohibitive to all but
145 the world’s largest corporations and governmental institutions. Still, classical computing overcame similar problems, so the future of quantum computing looks bright.

How Much Have You Learned?

Directions: Take five minutes to actively read the following passage by 1) noting the keywords, 2) jotting down margin notes next to each paragraph, and 3) summarizing the big picture. When you're done, compare your work to the Answers and Explanations at the end of the chapter.

This passage was adapted from an article entitled "John Snow Knew Something" published in a popular history magazine in 2018.

Few would deny that doctors use critical thinking to solve problems, but most imagine a difference between the practice of medicine and, say, the methods a police detective might use to solve a case. In fact, medical researchers have long used forensic methods of detection and analysis. The case of John Snow, a 19th-century anesthesiologist, is often said to have ushered in the modern era of epidemiology, the branch of medicine that tracks the incidence and distribution of diseases and proposes solutions for their control and prevention.

It would not be until 1861 that Louis Pasteur would propose the link between microorganisms and disease, now known as the germ theory. Before Pasteur's breakthrough, the predominant explanation for the cause of most illnesses was the so-called miasma theory, which held that noxious fumes and pollution—quite literally, as the theory's name implies, "bad air"—were responsible for making people sick. Consequently, during the 1854 outbreak of cholera in Westminster, London, doctors and government officials alike blamed "miasmatic particles" released into the air by decaying organic matter in the soil of the River Thames.

Despite the widespread acceptance of the miasma theory, there were those, Snow included, who were skeptical of

this view. Snow would not have known, as doctors do today, that cholera is caused by a bacterial infection, *Vibrio cholerae*. Nevertheless, he was convinced that the spread of the disease was caused by some form of matter passed between individuals, likely through contaminated water.

To demonstrate this, Snow targeted a particularly deadly outbreak in the Soho district of Westminster in London. From August 31 to September 3, 1854, 127 people in the area died of cholera. Within a week, that number had risen to over 500. Snow took to the streets. Speaking to residents of the area, he found a commonality among them: most of the victims had used a single public water pump located on Broad Street. Though he was unable to find conclusive proof that the pump was the source of the outbreak, his demonstration of a pattern in the cholera cases prompted authorities to disable the pump by removing its handle. The epidemic quickly subsided.

Soon after the Broad Street pump was shut down, Snow's continued investigation provided additional evidence that contaminated water was the source of the outbreak. Snow created a dot map of the cases of cholera in London and demonstrated that they occurred in areas where water was supplied by two companies that obtained their water from wells near the Thames. Investigation of these wells showed that they had been dug three feet from a cesspit that was leaking sewage into the surrounding soil. Snow also discovered that there were no cases of cholera among workers in a

brewery close to the Broad Street pump.
80 These workers were provided a daily allowance of beer, which they drank instead of water, and although the beer was brewed using the contaminated water, it was boiled during the brewing
85 process. This revelation provided a practical solution for the prevention of future outbreaks.

Snow is now hailed as the “father of modern epidemiology,” and the radical
90 nature of his approach—formulating a new theory, substantiating it with verifiable evidence, and proposing preventative action—is fully appreciated. At the time, however, not
95 all were convinced, at least publicly, of Snow’s findings. As anxiety over the

outbreak flagged, government officials replaced the handle on the Broad Street pump and publicly denounced Snow’s
100 conclusions. It seems they felt that the city’s residents would be upset and disgusted to have the unsettling nature of the well’s contamination confirmed. It wasn’t until 1866, more than a decade
105 after Snow’s original investigation and theory—when another cholera outbreak killed more than 5,500 residents of London’s East End—that officials working in public health began to
110 accept the link between contaminated water and certain kinds of illness and to take appropriate actions to quell such outbreaks.

Reflect

Directions: Take a few minutes to recall what you've learned and what you've been practicing in this chapter. Consider the following questions, jot down your best answer for each one, and then compare your reflections to the expert responses on the following page. Use your level of confidence to determine what to do next.

Why do SAT experts note keywords as they read?

What are the three categories of keywords? Provide some examples from each category.

- _____
 - Examples: _____
- _____
 - Examples: _____
- _____
 - Examples: _____

Why do SAT experts jot down margin notes next to the text?

What are the elements of a strong big picture summary?

Expert Responses

Why do SAT experts note keywords as they read?

Keywords indicate what the author finds important, express her point of view about the subject and details of the passage, and signal key points in the passage structure. Keywords are the pieces of text that help test takers see which parts of the passage are likely to be mentioned in questions and help test takers to distinguish between correct and incorrect answer choices about those parts of the passage.

What are the three categories of keywords? Provide some examples from each category.

- *Opinion and Emphasis*
 - Examples: *indeed, quite, masterfully, inadequate*
- *Connection and Contrast*
 - Examples: *furthermore, plus, however, on the contrary*
- *Evidence and Example*
 - Examples: *consequently, since, for instance, such as*

Why do SAT experts jot down margin notes next to the text?

Margin notes help the test taker research questions that ask about details, examples, and arguments mentioned in the passage by providing a “map” to their location in the text. Margin notes can also help students answer questions about the passage structure and the purpose of a specific paragraph.

What are the elements of a strong big picture summary?

A strong big picture summary prepares a test taker to answer any question about the main idea of the passage or the author’s primary or overall purpose in writing it. After reading the passage, SAT experts pause to ask, “What’s the main point of the passage?” and “Why did the author write it?”

Next Steps

If you answered most questions correctly in the “How Much Have You Learned?” section, and if your responses to the Reflect questions were similar to those of the SAT expert, then consider strategic reading and passage mapping an area of strength and move on to the next chapter. Come back to this topic periodically to prevent yourself from getting rusty.

If you don’t yet feel confident, review the material in “Reading Passage Strategies,” then try mapping the passages you found difficult again. As always, be sure to review the explanations closely. Finally, if keywords give you trouble, **go online** (www.kaptest.com/moreonline) for additional practice with keywords.

Answers and Explanations

Try on Your Own

This passage was adapted from an article titled “Quantum Computing: Where Is It Going?” published in a science magazine in 2018. It discusses the background and potential of quantum computing.

Pharmaceutical companies dream of a time when their research and development process shifts from looking for illnesses whose symptoms can be ameliorated by a specific drug to choosing a disease and creating a drug to eradicate it. Quantum computing maybe the key to that goal. The powerful modeling potential unlocked by quantum computing may also someday be employed by autonomous vehicles to create a world free of traffic jams. With plausible applications in so many fields, it is worthwhile to learn a bit about how quantum computing works.

Any understanding of quantum computing begins with its most basic element, the qubit. In classical computing, information is processed by the bit, the binary choice of zero or one. Qubits, on the other hand, allow for infinite superpositions between zero and one and thus can store and process exponentially more complicated values. Imagine showing someone where you live on a globe by pointing only to either the North Pole or the South Pole. While you are likely closer to one pole than the other, you need additional information to represent your specific location. If, however, you could provide your home’s latitude and longitude, it could be located without any additional information. The power of quantum computing lies in the ability to express precise information in a single qubit.

QC: big potential

QC based on qubits – can store more values

Qubit > bit, much more data

ANALYSIS

Pre-passage blurb: Based on the article’s title, you can expect to see a discussion of the past and future of quantum computing.

¶1: The author claims that quantum computing may help solve two big problems—new pharmaceuticals and traffic management. Because of this potential, she says, it’s good to learn about quantum computing. Expect some of that background information in paragraph 2.

SAT Reading Strategy: Don’t panic when confronted with unfamiliar or scientifically advanced subject matter. Pay attention to the author’s purpose for discussing it.

¶2: The basis for quantum computing is the qubit, a much more powerful way to store and process information than the bit (which is what we currently use). The author illustrates this with the “globe” example.

SAT Reading Strategy: When you encounter an example or analogy, always ask, What does this illustrate or explain?

Quantum computing may help
40 scientists and engineers overcome
another barrier by reducing
energy output while increasing
computational speed. The positive
correlation between energy output
45 and processing speed often causes
classical computers to “run hot” while
processing overwhelming amounts of
data. Along with their ability to store
multiple values simultaneously,
50 qubits are able to process those values
in parallel (instead of serially). How
does processing in parallel conserve
energy? Suppose you want to set the
time on five separate alarm clocks
55 spaced ten feet apart. You’d have to
walk to each clock to change its time.
However, if the clocks were connected
such that changing the time on one
immediately adjusted the other four, you
60 would expend less energy and increase
processing speed. Therein lies the (benefit)

Qubits =
parallel
processing

Faster AND
cooler

While quantum computing has
moved beyond the realm of the
65 theoretical, (significant barriers) still
stand in the way of its practical
application. One barrier is the difficulty
of confirming the results of quantum
calculations. If quantum computing
70 is used to solve problems that are
impossible to solve with classical
computing, is there a way to “check”
the results? Scientists hope this paradox
may soon be resolved. As a graduate
75 student, Urmila Mahadev devoted
over a decade to creating a verification
process for quantum computing.
The result is an interactive protocol,
based on a type of cryptography called
80 Learning With Errors (LWE), that is
similar to “blind computing” used in
cloud-computing to mask data while
still performing calculations. Given
current limitations, Mahadev’s protocol

One barrier
to QC -
how to
check
results?

¶3: Another advantage: quantum computing is faster but cooler (current computers overheat). The reason is parallel processing, illustrated by the “five clocks” example.

SAT Reading Strategy: Rhetorical questions help you focus on the author’s point in a paragraph and her reason for writing it.

¶4: Here, the passage shifts to obstacles to quantum computing. One problem: when they solve extremely complex problems, regular computers can’t check them. One scientist is working on a solution, and the author is optimistic that it will work out in the next 20 years or so.

85 remains purely theoretical, but rapid progress in quantum computing combined with further refinement of the protocol will likely result in real-world implementation within the next decade or two.

Probably will get solved

90 It is unlikely that early pioneers in the field, including Stephen Wiesner, Richard Feynman, and Paul Benioff, could have foreseen the rapid progress that has been made to date. In 1960, when Wiesner first developed conjugate coding with the goal of improving cryptography, his paper on the subject was rejected for publication because it contained logic far ahead of its time. Feynman proposed a basic quantum computing model at the 1981 First Conference on the Physics of Computation. At that same conference, Benioff spoke on the ability of discrete mechanical processes to erase their own history and their application to Turing machines, a natural extension of Wiesner's earlier work. A year later, Benioff more clearly outlined the theoretical framework of a quantum computer.

QC pioneers - 1960s - 80s

The dawn of the 21st century brought advancements at an even more impressive pace. The first 5- and 7-qubit nuclear magnetic resonance (NMR) computers were demonstrated in Munich, Germany, and Santa Fe, New Mexico, respectively. In 2006, researchers at Oxford were able to cage a qubit within a "buckyball," a buckminsterfullerene molecule, and maintain its state for a short time using precise, repeated microwave pulses. The first company dedicated to quantum computing software, IQB Information Technologies, was founded in 2012, and in 2018, Google announced the development of the 72-qubit Bristlecone chip designed to prove "quantum supremacy," the ability of quantum

QC sped up in 2000s

¶15: The pre-passage blurb indicated that the passage would cover quantum computing's past, and here it is. The point of this paragraph is that early developers of quantum computing (the author names three of them) would be surprised by how quickly it has developed.

¶16: This gives a little more about the past. Progress in quantum computing really took off during the 2000s. The author supports that point with examples of companies that have created and improved quantum computers.

SAT Reading Strategy: The SAT doesn't expect you to know the definitions of technical terms and phrases. The test will ask you why the author has included these details or how they function in the paragraph.

computers to solve problems beyond the reach of classical computing.

135 With progress in quantum
computing accelerating, it seems
inevitable that within a few decades, the
general population will be as familiar
with quantum computing as they now
are with classical computing. At present,
140 quantum computing is limited by the
struggle to build a computer large
enough to prove quantum supremacy,
and the costs associated with quantum
computing are prohibitive to all but
145 the world's largest corporations and
governmental institutions. (Still), classical
computing overcame similar problems,
so the future of quantum computing
looks bright.

QC still
difficult,
but bright
future

¶17: The passage ends on a high note: quantum computing will “inevitably” become popular and its future is “bright.” The author acknowledges obstacles, but clearly implies that she expects them to be overcome.

BIG PICTURE

Main Idea: Quantum computing has many potential uses despite current obstacles.

Author's Purpose: To explain some fundamental principles of how quantum computing works to show its enormous potential over classical computing and to give a brief history of its development to anticipate how it can overcome current limitations

As with the other passages in this chapter, don't worry about whether you used the exact language found in the expert's map and summary. Instead, focus on how the expert used the skills and strategies outlined here to prepare himself to tackle the question set with speed and confidence.

How Much Have You Learned?

This passage was adapted from an article entitled “John Snow Knew Something” published in a popular history magazine in 2018.

Few would deny that doctors use critical thinking to solve problems, but most imagine a difference between the practice of medicine and, say, the methods a police detective might use to solve a case. In fact, medical researchers have long used forensic methods of detection and analysis. The case of John Snow, a 19th-century anesthesiologist, is often said to have ushered in the modern era of epidemiology, the branch of medicine that tracks the incidence and distribution of diseases and proposes solutions for their control and prevention.

Snow's work used investigation, changed medicine

It would not be until 1861 that Louis Pasteur would propose the link between microorganisms and disease, now known as the germ theory. Before Pasteur's breakthrough, the predominant explanation for the cause of most illnesses was the so-called miasma theory, which held that noxious fumes and pollution—quite literally, as the theory's name implies, “bad air”—were responsible for making people sick. Consequently, during the 1854 outbreak of cholera in Westminster, London, doctors and government officials alike blamed “miasmatic particles” released into the air by decaying organic matter in the soil of the River Thames.

1854 - didn't know about germs; miasma theory

Despite the widespread acceptance of the miasma theory, there were those, Snow included, who were skeptical of this view. Snow would not have known, as doctors do today, that cholera

ANALYSIS

Pre-passage blurb: The article is about someone named John Snow, who must be a historical figure of some importance. Beyond that, however, there's not too much to go on in this blurb.

¶1: The author provides some background on John Snow. Today, he is known for changing how doctors track and prevent diseases, apparently by using methods often associated with detectives and investigations. The rest of the passage will illustrate why he was so important.

¶2: This paragraph sets the stage. At the time of the cholera outbreak in 1854, people did not know that germs and bacteria caused the disease.

¶3: The author contrasts (note the keywords “Despite” and “Nevertheless”) Snow's theories with the popular ideas of his time. He thought cholera might be passed through contaminated water.

40 is caused by a bacterial infection,
Vibrio cholerae. Nevertheless, he was
convinced that the spread of the disease
was caused by some form of matter
passed between individuals, likely
45 through contaminated water.

To demonstrate this, Snow targeted
a particularly deadly outbreak in
the Soho district of Westminster in
London. From August 31 to September
50 3, 1854, 127 people in the area died of
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60 demonstration of a pattern in the
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handle. The epidemic quickly subsided.

Soon after the Broad Street pump
65 was shutdown, Snow's continued
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70 and demonstrated that they occurred in
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these wells showed that they had been
75 dug three feet from a cesspit that was
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brewery close to the Broad Street pump.
80 These workers were provided a daily
allowance of beer, which they drank
instead of water, and although the beer
was brewed using the contaminated
water, it was boiled during the brewing
85 process. This revelation provided a

Snow: cholera from
contam.
H₂O

Proof from
interviews
- all used
same pump

Water from
contam.
wells

Boiling first
prevented
disease

¶4: Snow investigated the area and interviewed people. He demonstrated that a specific water pump was “ground zero” for the outbreak and got it turned off.

¶5: Through further investigation, Snow showed that leaking cesspools were the source of contamination and used his observations at a nearby brewery to deduce that boiling water before drinking would prevent the disease.

practical solution for the prevention of future outbreaks.

Snow is now hailed as the “father of modern epidemiology,” and the radical nature of his approach—formulating a new theory, substantiating it with verifiable evidence, and proposing preventative action—is fully appreciated. At the time, however, not all were convinced, at least publicly, of Snow’s findings. As anxiety over the outbreak flagged, government officials replaced the handle on the Broad Street pump and publicly denounced Snow’s conclusions. It seems they felt that the city’s residents would be upset and disgusted to have the unsettling nature of the well’s contamination confirmed. It wasn’t until 1866, more than a decade after Snow’s original investigation and theory—when another cholera outbreak killed more than 5,500 residents of London’s East End—that officials working in public health began to accept the link between contaminated water and certain kinds of illness and to take appropriate actions to quell such outbreaks.

Snow not accepted at the time

1866 – another epidemic

¶16: Another contrast: Snow is now seen as a pioneer but wasn’t appreciated at the time. It took another epidemic for officials to buy in to his theory.

BIG PICTURE

Main Idea: John Snow’s investigative approach to explaining the cholera epidemic of 1854 ushered in the modern era of epidemiology.

Author’s Purpose: To demonstrate how Snow’s use of interviews, maps, and data altered the way doctors study the spread and prevention of disease
