

Can We Afford Later High School Start Times?

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The issue of high school start times began to receive national attention in the late 1990s when Minneapolis and Edina, Minnesota delayed their high school opening bells in response to a Minnesota Medical Association campaign publicizing widespread sleep deprivation among teenagers. According to the National Sleep Foundation (NSF), there are now at least 60 school districts in 26 states that have changed their high school start times. NSF, a private non-profit organization dedicated to keeping the public informed about sleep research, also reports that 140 school districts in 40 states are considering changes.¹ Locally Alexandria, Arlington County and Falls Church City have all changed their school start times and Manassas City and Fairfax County are considering it.

The History of Later Start Times in Fairfax County

The Fairfax County School Board first considered the issue in 1997 when it created a Task Force to Study High School Opening Times. The Task force met for six months and submitted its report to the School Board on June 29, 1998.² The Task Force found that adolescents generally are not getting the nine hours of sleep they need and that sleep deprivation has a negative impact on learning, health and academic performance. They concurred that teens who do not get enough sleep are at risk for automobile crashes, depressed moods, and problems with peer and adult relationships. The Task Force recognized that later high school and middle school start times can reduce unsupervised after-school time, potentially lessening criminal and other dangerous behaviors. However, accommodating student activities, athletics and work hours were major considerations for which it had no satisfactory solution. The Task Force recommended that technical and strategic expertise beyond what is available to FCPS should be considered to facilitate transportation improvements and/or enable changes in bell schedules. It also concluded that later high school and middle school bell times, and a sleep-awareness education campaign, could benefit the entire community. A community, student and employee survey was recommended to determine if there is broad-based support for changing school start times.

In 1998, Fairfax County Public Schools' (FCPS) three-tiered bell schedule had most high schools and middle schools starting around 7:20 a.m. and elementary

schools starting around either 8:35 a.m. or 9:10 a.m. This allowed a single school bus to handle up to three routes each morning and afternoon. The Task Force considered three options for changing the bell schedule but felt that each had a significant disadvantage. Therefore, it did not endorse or recommend any of these options:

20 Minute Slide (starting all schools 20 minutes later)-- may not provide enough sleep benefit to warrant the change in the elementary day.

40 Minute Slide (starting all schools 40 minutes later)-- makes the elementary school day unacceptably late in beginning and ending; requires a major adjustment in scheduling student activities.

Two Bell Flip (high schools and middle schools start at 9:00, elementary schools start at 8:00)-- this option has a \$31 million price tag, not including additional personnel costs; requires major change in scheduling student activities; athletic program could not be maintained in its present form.

Other School Districts

In 1998, Maryland's Montgomery County Board of Education also studied the possibility of switching to a later start time for high school which opened at 7:25. But School Superintendent Jerry West put an end to Montgomery County's review of start times by writing "based on my review of the options available at this time and the lack of evidence that changing high school bell times will result in improved student performance. I cannot support the increased costs of some options and the resultant disruption to schools, students, families and the community."³ Montgomery County has 1,252 buses which transport 96,000 students.⁴ Other districts, like Loudoun County Public Schools in Virginia, which operates and maintains a fleet of 625 school buses serving 35,000 students in 69 schools, can and do utilize later high school start times. In Loudoun County, high schools begin at 9:00, middle schools begin between 8:30 - 8:40 and elementary schools begin at 7:50.⁵ Smaller school districts which have changed their bell schedules (like Arlington, Virginia and Wilton, Connecticut) did not face the massive transportation constraints which impede Fairfax County's efforts.

Later Start Times in Arlington ^{6 7 8}

Arlington, Virginia has 20 schools and 19,000 students. In September 2001, the public schools of Arlington adjusted the start times of their three high schools so that schools both started and ended 45 minutes later than in the previous school years. High schools in Arlington now start at 8:19 and dismiss at 3:01. The change was made after several years of planning, and out of concern that early start times had a negative effect on high school students, particularly on academic performance and alertness. The change in high school start times was accomplished by moving the start time for the middle schools from 8:10 to 7:50, in order to accommodate bus runs. The new schedule was implemented with very little confusion since Arlington conducted an extensive community dialog beforehand and a public information campaign in several languages during the summer prior to the change.

Results for Arlington high school students were generally positive. There was a very slight improvement in overall average first period grades, but not a significant change. Students and teachers reported that students were more alert and more often participating in first period classes. Middle school students and their teachers reported decreased alertness and readiness for school after the schedule change. On average eighth graders received lower grades in their first period classes than the previous school year, but seventh graders received higher grades. Initially middle school students were tardy more often after the schedule change than before, but that faded out over time.

The majority of Arlington's high school students (65 percent) reported that they were participating in extracurricular activities as much or more than before the schedule change. Twenty-nine percent indicated that they were participating less in activities. The schedule change presented a dilemma for middle school bus schedules. Prior to the change, buses for middle school students did not leave school until 40 minutes after dismissal, due to bus availability. The new schedule increased that wait time to an hour. Middle school activities coordinators were hired and the schedule of activities after middle school was organized so that students might have a period of studying or tutoring and a period of sports or recreational activity. Instead of being a liability, this additional time was felt by many to be an asset. The

general impression of the community is that high school students are better off with the new schedule, middle school students were not significantly disadvantaged, and there were some benefits for them.

Wilton LWV School Start Time Report

The Wilton School District in Connecticut has five schools and 4,300 students. In 2002, the Wilton League of Women Voters (WLWV), conducted a study on school start times. This was inspired by proposed legislation which would have prohibited Connecticut schools from ringing their opening bells before 8:30 a.m. WLWV brought their findings to the community and new start times were implemented by the Wilton School District in the fall of 2003. This was achieved by flipping the upper elementary start (originally 8:15 a.m.), with the middle school/high school start (originally 7:35 a.m.), giving teenagers 40 more minutes of time in the morning to sleep.

WLWV's School Start Time Study Report⁹ committee looked at the research available on adolescent sleep issues. The following is a synopsis of their findings. When needed for clarification, this synopsis was supplemented with material from the National Sleep Foundation website.¹⁰

Why does it seem harder for adolescents to get up in the morning than for younger children? And why don't they just go to bed earlier?

Two reasons: circadian rhythms and puberty. Sleep research has explored the phenomenon of human circadian rhythms—daily cycles of alertness alternating with sleepiness—and the biological clock that governs them. The alertness period of the cycle is strong enough to keep people awake during specific times of the day even when they should be exhausted—an effect very familiar to jet-lagged travelers and night-shift workers. Circadian rhythms differ among different age groups—teenagers' cycles of alertness and drowsiness undergo a phase-delay that makes them wide-awake when their younger siblings—and their parents—are falling asleep.

The hormones of puberty also can reset the biological clock; in fact, one of the first signs of puberty is change in sleep schedule. With the onset of puberty, the rush of hormones literally rewires the cerebral cortex of the brain, increasing the amount of growth hormone, which is secreted during sleep. Other hormones which control physical and sexual development are also released during sleep. Dr. Mary Carskadon, a leading

sleep researcher and Director of the Bradley Hospital Sleep and Chronobiology Research Lab, has determined that melatonin, the hormone that communicates the pulse of the biological clock to the body and tells the body to prepare for sleep, is secreted later in the evening for adolescents than for younger children. This pushes teens' natural fall-asleep time later and creates a zone around 9 or 10 pm when it is very hard for them to fall asleep. Sleep researchers have found that the average teenager's fall-asleep time is around 11 pm. Of course, this pushes the natural wake-up time later. Dr. Carskadon also discovered that students' melatonin levels were still elevated into the school day. "Their brains are telling them it's nighttime," she says, "and the rest of the world is saying it's time to go to school."

Many researchers say that teen sleep needs are even higher than those of younger children—teenagers need 9-10 hours of sleep per night to be at their best both physically and mentally. Dr. Carskadon reports that, on average, teens are getting about 7½ hours of sleep on school nights. Moreover, 25% of the kids are getting 6½ hours of sleep or less on school nights. In the context of what they need to be optimally alert, teens are building huge sleep deficits, night after night after night. (Carskadon, 1999)

Don't teenagers make up for lost sleep by sleeping in on the weekends?

Yes, somewhat. Sleep deprivation is cumulative. Researchers call this cumulative sleep deprivation "sleep-debt." The lack of sleep must be made up or paid back in order for optimal brain functioning to occur. Dr. William Dement (The Promise of Sleep) and the University of Minnesota Center for Applied Research and Educational Improvement (CAREI, 1998 and 2001) have investigated the relationship between sleep patterns and sleep-debt. Dr. Carskadon has also studied sleep-debt and how teenagers make up for lost sleep. They observed an adolescent pattern of "sleep binge-ing" [*sic*] on the weekends to resolve sleep debt. However, Dr. Carskadon and others have found that sleeping longer than a couple of hours past one's usual wake-up time can wreak havoc on the adolescent biological clock, making the Monday morning return to school more difficult than ever.

The University of Minnesota Studies

At the request of the Minneapolis and Edina, Minne-

sota school districts, the University of Minnesota's Center for Applied Research and Educational Improvement (CAREI) conducted 2 major studies (November 1998 and August 2001) which evaluated the later school start time experience. Among other things, CAREI looked at high school students' letter grades pre- and post-time-change. Their research showed a slight, but not significant, improvement in grades. However, they also found several other results that were statistically significant, including: attendance among all students increased between 1995-2000; and Minneapolis's dropout rate dropped two percent each year for all students.

Another part of the Minnesota research surveyed students regarding sleep, school, and lifestyle in three similar school systems—one of which had changed its start time. These are the statistically significant findings related to learning:

1. Students in the school with a later start time reported an almost identical bedtime to that of students in other schools. In other words, as a group, the students with a later start time are not staying up any later because, as some people have theorized, they know they can make up their sleep in the morning. Consequently, teens in schools that changed their start times were receiving about 5 hours more sleep a week than students in schools that had not made the switch.
2. Fewer students reported falling asleep in class, arriving late to school, and feeling tired during the school day in the later-starting school than in other schools.
3. Students in all three districts who reported less sleep overall were the sleepiest in school and were the ones who reported receiving the lowest grades.
4. The students at the later-starting school reported higher grades overall than those in districts with earlier start times.

Interpreting the scientific evidence of the effect of school start times on learning is complex. Sleep researchers, in numerous studies, have found statistically significant correlations between the amount of sleep and mastering learning-related skills; the amount of sleep and later school start times; the amount of sleep and self-reported academic performance; and later school start times and lowered absenteeism, tardiness, and drop-out rates. These studies do not imply a cause and effect relationship. However, they indicate correlations that are unlikely to occur by

chance alone.

The consequences of sleep deprivation during the teenage years are particularly serious. Learning suffers because sleep deprivation impairs the ability to be alert, pay attention, solve problems, cope with stress and retain information. Other consequences include:

1. Increased risk of driving accidents, injuries and death: According to the National Highway Traffic Safety Administration (NHTSA, 1994) drowsiness and fatigue account for at least 100,000 police reported crashes each year, killing more than 1,500 and injuring 71,000. These are not fender benders. In North Carolina and New York, studies showed that young drivers under 25 were involved in more than 50% of the fall-asleep crashes. Also, sleep deprivation has been shown to heighten the effects of even a small amount of alcohol. NHTSA says that teenagers are unaware of this and don't recognize the extent of the impairments they experience.

2. Increased likelihood of stimulants/substance abuse: The National Institutes of Health report the use of stimulants (caffeine, nicotine, and alcohol among them) to compensate for lack of sleep. Students use stimulants to stay up late to finish their homework; then, when awakened early for school, they try once more to overcome the effects of their late night hours and their high morning melatonin levels by using more stimulants.

3. Behavioral issues: Studies show that a lack of sleep can lead to emotional and behavioral problems such as irritability, depression, poor impulse control and violence. Also, proponents of delayed high school start times argue that a later start and later dismissal would limit the time adolescents are unsupervised in the afternoon. Those returning home from school to an empty house (latch-key children) are more prone to risky behaviors during this time compared to their peers who are at home with supervision.

New Efforts in Fairfax County

In January 2004, an organization named SLEEP (Start Later for Excellence in Education Proposal) was started by Phyllis Payne and Sandy Evans, Fairfax County parents. SLEEP's goal is to change FCPS middle and high school start times to later in the morning to correspond with teen sleep needs and improve health, quality of life, and school performance.

Kaye Kory, Mason District School Board Member,

cited SLEEP in a December 12, 2005, article in the Washington Post and urged further study of possible options. "The problem of early start times developed out of the transportation needs of a 166,000-student system," Ms. Kory said. "The early start time allows a single bus to make three morning and three afternoon runs to transport high school, middle school and elementary school students, in that order."¹¹

On February 10, 2005, the School Board voted to hire a consultant to evaluate the current FCPS pupil transportation system, including an evaluation of the current 3-tier bell schedule, and recommend changes that would support later start times for secondary schools. A contract with Management Partnership Services, Inc., (MPS) was signed in July 2005. The School Board appointed a ten member Advisory Group to work with MPS.

Review of Current Bus and Bell Schedules

"Over 117 thousand average daily transported students are bused using approximately 1,136 assigned buses on a three-tier bell schedule to 242 schools and educational programs," MPS stated in a report issued January 12, 2006.¹² Ideally, a three-tier bell schedule staggers the school opening times so a single bus can cover three morning routes and three afternoon routes. FCPS' three-tier bell schedule loosely clusters as:

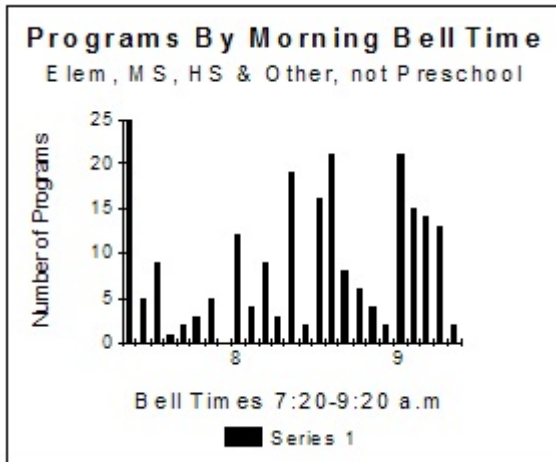
Approximate Time Corridors¹³

Tier	Morning Start Times	Afternoon End Times
1	7:20-7:30	2:10-2:20
2	8:00-8:35	2:50-3:10
3	8:45-9:15	3:20-3:50

According to MPS, FCPS' bell schedule has "evolved from a distinct 3-tier schedule to a 'rolling' bell schedule with minimal separation (some as few as 5 minutes) between schools."¹⁴ This creates severe time constraints. Most students are delivered to the high schools approximately 20 to 30 minutes before start time so the buses can leave in time to pick up their next students. Since there are only 10-15 minutes between Tier 2 and 3, "only about 58% of buses are able to perform more than two routes each morning."¹⁵

To illustrate the "rolling" bell schedule, the chart below¹⁶ indicates the number of programs/schools opening at a given time between 7:20 and 9:20 in the

morning. Each bar represents a 5 minute increment; 8:00 and 9:00 are shown for reference.



The morning transportation window is 1 hour and 55 minutes (from 7:20-9:15). But in the afternoon, the transportation window is only 1 hour and 40 minutes (from 2:10-3:50). This is because elementary schools have an instructional day which is typically 20 minutes shorter than the secondary schools on Tuesday through Friday. [On Mondays, most elementary schools have an even shorter day—4 hours and 10 minutes in school.] Since the Tier 3 routes are primarily elementary schools, buses have 20 minutes less time to get from Tier 2 school to Tier 3 schools than they would if the secondary schools were in Tier 3 instead.

Scenarios for Change

MPS studied several scenarios for changing the bus schedules to allow the high schools to start later. The first three scenarios (A, B & C) included the following assumptions and constraints set by the School Board:

1. High schools start between 8:00 – 9:00 a.m.
2. No restriction on bell time placement of middle and elementary schools
3. No changes made to existing length of instructional day to each school.
4. Primary school age children will not wait at stops in darkness (civil twilight). Therefore they should not be at the bus stop before 7:08 a.m. Eastern Daylight Time or get off the bus after 5:17 p.m. Eastern Standard Time.
5. Current ride time standards used in policies and guidelines will be maintained.
6. Current arrival/departure windows will be maintained.

MPS was held to these constraints in creating Scenarios A, B & C with later high school start times. MPS used the Chantilly, Lake Braddock, Marshall, Mt. Vernon and Woodson pyramids as a representative sample in their simulations and found that “the number of fleet resources could be expected to increase by a range of 8 to 21 percent, with an overall average of 16 to 17 percent.”¹⁷ They believe this represents a ‘floor’ in the transportation cost of moving the high school opening bells to a later time.

After considering the results of the initial models, the Advisory Group and the School Board revised the assumptions and constraints.

1. The total transportation window should be reduced by 15 – 20 minutes to 1 hour and 35 minutes in the morning and the afternoon.
2. High schools should start between 8:15 to 8:30 a.m.
3. Middle schools should start in the same tier or after high schools
4. Elementary schools should start around 7:50 to 8:00 a.m., but in no case before 7:35 a.m.
5. Elementary students should not be at their stops before civil twilight.

MPS then developed two new scenarios using these revised assumptions and constraints:

Revised School Start Time Parameters¹⁸

Scenario	Tier 1	Tier 2	Tier 3
D	Elementary School 7:45	Middle School 8:15-8:30 or 20-30 min later High School 8:15 - 8:30	Elementary Schools 9:15
E	Elementary School 7:45	Elementary 8:20 High School 8:15-8:30	Elementary School 9:15 Middle Schools 9:15

Costs of Proposals

“The change in resource requirements in scenarios D and E resulted in a combined estimated 51 percent increase in the number of buses required to transport students under a bell time configuration with the high schools’ opening bell times changed from 7:20 A.M. to 8:30 a.m.” MPS stated. “When applied on a district-wide basis, this would result in an increase of 637 buses in the fleet, including an additional 579 assigned buses and 58 spare buses (assuming a 10 percent spare ratio). To do this would require an estimated increase

of \$44 million in annual amortized capital and operating costs.”¹⁹

As a portion of the total FCPS budget, this size of expenditure could be compared to the \$46.5 million that would cover a three percent pay raise for employees. The School Board’s advertised budget for Fiscal year 2007 includes an overall increase of \$184.2 million or 9.5 percent over the FY 2006 approved budget and \$94.4 million or 4.7 percent over the current year budget. The FY 2007 total funding for transportation of \$108.0 million provides for \$71.8 million in compensation, mostly for bus driver salaries. In addition, the budget funds \$7.1 million in fuel, \$17.7 million in bus fleet maintenance, and \$13.5 million in replacement buses and vehicle lease purchase payments.

Key Factors Influencing Results

MPS cited four primary reasons why moving the high schools to the middle tier would result in a very significant increase in fleet size and transportation operating and capital costs.

1. Impact of varying instructional day lengths. The length of the instructional day at the elementary schools is typically 20 minutes shorter than the day at the secondary schools. Therefore, a 30 minute separation in the morning start times between a high school on Tier 2 and an elementary school on Tier 3 will collapse to just a 10 minute separation when dismissal bells ring in the afternoon. This is avoided if the high schools are placed on the last tier or early on the first.

2. Reduction in transportation window from approximately one hour and 55 minutes to one hour and 35 minutes. The revised set of constraints established the minimum start time of the elementary schools to be no earlier than 7:45 a.m. The present structure has most of the high schools starting at 7:20 a.m., so the effect is a 17 percent reduction (20 minutes) in the amount of time available to transport the same number of students. This requires additional buses.

3. Morning twilight conflicts for the elementary students require “split” routes. With elementary schools starting at 7:45, a significant number of bus routes had to be shortened to avoid having elementary school students waiting at their bus stops before civil twilight. This, in turn, caused an increase in the number of buses needed to transport the same number of students. The additional buses needed for this purpose represented approximately 40 percent of the

total fleet increase required in Scenarios D and E.

4. Nontraditional programs greatly extend route times. Bus routes that serve open programs, magnet programs, alternative highs schools, FECEP (Head Start), gifted and talented programs, etc., limit multiple trip pairing options because buses must transport students across greater distances at a lower passenger capacity utilization.

Further Study

In its January 2006 report, MPS did not recommend adopting the costly Scenarios D or E. Instead, they recommended modeling the cost and service impact of a later high school start time under the following three options:

“Option 1-Develop a model assuming one (1) hour and 55 minute morning series time window, with no change in the length of elementary instructional day.

Option 2-Develop model assuming an increase in the length of the elementary instructional day to make it equal to the middle schools and high schools, but leaving the length of the morning series time window at one (1) hour and 35 minutes, as in the final models developed in the first phase of this study.

Option 3-Develop model combining options 1 & 2.”²⁰

Phase 2 Scope of Work

On February 9, 2006, the School Board postponed consideration of an amendment by Stu Gibson to contract with MPS. Mr Gibson, the Hunter Mill District School Board member, had proposed loosening specific constraints for Phase 2. At the School Board work session held April 3, Ms. Kory presented the following items for inclusion in the Scope of Work for Phase 2 of the MPS study:

Each of the following represents discrete tasks that are separable, the information from which can be used for different purposes. The contractor, however, shall also identify the least expensive method of achieving later high school start times.

1. Determine and quantify the potential reductions in current requirements for school buses by implementing the following:

Modification or elimination of transportation for students attending magnet programs

Modification or elimination of transportation for students attending GT centers outside of their base school boundaries.

Modification or elimination of transportation to high school academies, which is in conflict with base school

transportation.

2. Determine and quantify potential reductions in requirements for school buses by consolidating bus stops.

3. Determine and quantify potential reductions in requirements for school buses by increasing the walking distance for secondary students to 2 miles from the current 1.5 miles.

4. Determine and quantify potential reductions in requirements for school buses by changes to school attendance areas to make them more compact, contiguous, and amenable to more efficient transportation routes and schedules.

5. Taking advantage of the Phase 1 study results, develop a rolling bell schedule that has schools sequenced as follows within a 1 hour and 45 minute bell window with the first bell starting at 8:00 a.m.:

First Bell: Elementary schools

Second Bell: All high and secondary schools and elementary

Third Bell: All middle schools and remaining elementary schools

It is acceptable to modify the length of the instructional day for elementary schools by +/-5 minutes if this avoids the need to add buses.

Elementary Schools with longest and shortest runs in tiers may be used as needed to reduce civil twilight or other conflicts.

6. Assess other reasonable scenarios for later high school start times offered by the community, staff, or School Board members and identify those scenarios - if any - that the School Board should consider to achieve the objective of finding the most cost effective and efficient method of achieving the goal of later start times. At least one scenario will include a variation of the above rolling bell schedule model without the 1 hour 45 minute bell window constraint and without adding buses.

During the discussion of these study topics, several school board members said they would not support eliminating buses for GT centers or high school academies. Other questions were raised about increasing walking distances, considering boundary changes, and whether the costs would be acceptable. However there was a consensus that Phase 2 could provide cost

information for the broad range of options.

On April 6, 2006, the School Board voted to go ahead with a Phase 2 study. According to Ms. Kory, the Phase 2 Study will probably take about six months. The School Board will seek public comments on any recommendations in the report.

Endnotes:

1. Data from Jessica Steinitz, Research Manager, National Sleep Foundation, 3/20/06
2. Report of the Task Force to Study High School Opening Times, June 29, 1998, Fairfax County Public Schools. Accessed via website of Sleep In Fairfax, <www.sleepinfairfax.org>
3. Kaufman, Marc. "In the Dark," *The Washington Post Magazine*, 2/25/01. Pp13 & 22
4. <www.mcps.k12.md.us> Montgomery County Public Schools website accessed 4/8/06
5. <www.loudoun.k12.va.us> Fairfax County Public Schools website accessed 4/8/06
6. "Impact of 2001 Adjustments to High School and Middle School Start Times," Office of Planning and Evaluation, Arlington Public Schools (APS), June 2005.
7. Mark Macekura, APS Director of Special Projects, interview by Jane Hilder, March 24, 2006
8. Libby Garvey, APS Board Member, interview by Jane Hilder, March 25, 2006
9. <www.wiltonlwv.org> Wilton League of Women Voters, School Start Time Study Report, June 2002, accessed March 2006
10. <<http://www.sleepfoundation.org>> National Sleep Foundation website, accessed March 2006
11. Kory, Kaye. "Ahead of Their Time," *The Washington Post*, Outlook, 12/12/05, p. B8
12. *K 12 Pupil Transportation Services Bell Time Analysis for the Fairfax County Public Schools*, Management Partnership Services, Inc, January 12, 2006 p.1
13. Ibid, p. 10
14. Ibid. p. 10
15. Ibid p.8
16. Ibid. Chart is modified from MPS "Morning Number of Programs by Starting Bell Time" p.11.
17. Ibid p. 15
18. Ibid p. 17
19. Ibid p. 20
20. Ibid p. 26