The League of Women Voters
of New Canaan

Report on Adolescent Sleep Needs And School Start Times

June 30, 2006

LWVNC Report
on
Adolescent Sleep Needs and School Start Times

Table of Contents

SLEEP AND ADOLESCENT HEALTH
POSITION STATEMENT

Based on research and its survey of the New Canaan school community, the League of Women Voters of New Canaan believes that adolescent sleep deprivation is a serious public health issue that must be addressed.

Inadequate sleep exacts a profound toll on students' learning, cognition, mental and physical health, behavior and safety. Sleep is not simply a resting state, but an active process that restores, replenishes and consolidates mental, physical and emotional function.

In order for the link between sufficient sleep and personal achievement to be better understood, the League recommends that information about sleep be incorporated into educational programs in New Canaan Public Schools.

As the current 7:30 a.m. start time is incompatible with the sleep needs of adolescents, the League also recommends that the New Canaan Public Schools investigate all options to implement a later opening bell for 7th through 12th graders. We believe that this action will help create a more productive learning environment and be more consistent with the developmental needs of our adolescents.

Community education is an important component of this initiative as well. The League will continue to provide programs and materials to inform the public about the importance of sleep and the factors that can contribute to sleep deprivation.

June 1, 2006

SLEEP AND ADOLESCENT HEALTH: FACT SHEET

"***Many people view sleep as merely a 'down time' when their brain shuts off and their body rests. But research reveals that a number of vital tasks carried out during sleep help to maintain good health and enable people to function at their best***."

~U.S. Department of Health and Human Services

- The drive to sleep is the most powerful biological urge. Sleep is not optional.
- Adequate sleep is essential for optimal functioning of the immune, metabolic, cardiovascular, and neurological systems.
- Sleep needs do not decrease through adolescence. This age group still needs the same 9- 10 hours of sleep per night that younger children do.
- The brain's prefrontal cortex (responsible for impulse control, planning, reasoning) completes its neurological connections during adolescence, a process that occurs predominantly during sleep.
- Adolescent sleep patterns shift later, due to a delay in the secretion of melatonin (the hormone that induces drowsiness) and to psychosocial factors associated with this age group.
- It is biologically impossible for a person to sleep more than he/she needs. Longer-than-average sleep is either catch-up for previous sleep deprivation, or the true expression of current sleep need.
- When sleep is cut short in the morning, the body does not receive its full percentage of REM sleep. REM sleep, during which brain waves are vigorous and dreams occur, is associated with the consolidation of memory and learning.

"Excessive sleepiness can have a profound negative effect on school performance, cognitive function, and mood and has been associated with other serious consequences such as increased incidence of automobile crashes."

~American Academy of Pediatrics' Working Group on Sleepiness in Adolescents/Young Adults

- Sleep deprivation has been shown to impair creativity, abstract thinking, problem-solving, innovation, concentration, attention, decision-making, coordination, and motor response times.
- It can cause irritability, moodiness, emotional instability, aggressiveness, and stress.
- Sleep deprivation is cumulative. Like a bank, regular deposits must be made to keep the balance current, and overdrawn accounts must be repaid. Each night of insufficient sleep adds to the burden of this "sleep debt."
- 77% of New Canaan high schoolers get 6 – 7 hours of sleep on school nights, according to the LWV surveys. With a 2-3 hour sleep deficit every night these high school students have 10 - 15 hours of accumulated sleep debt by Friday.

- Sleep deprivation increases the likelihood of stimulant and alcohol use.

- Sleep deprivation magnifies alcohol's effects on the body, increasing the impairment of cognitive abilities and motor coordination.

- 100,000 automobile accidents each year nationwide are caused by drowsy drivers. 55% of such crashes nationwide are caused by drivers 16 - 25 years old.

- In a national poll, 5% of adolescent drivers said they nodded off or fell asleep at the wheel in past year.

"Given that the primary focus of education is to maximize human potential, then a new task before us is to ensure that the conditions in which learning takes place address the very biology of our learners."

~ Mary A. Carskadon, PhD, Director of E.P. Bradley Hospital Research Laboratory and professor in Department of Psychiatry and Human Behavior at Brown University School of Medicine

- In communities that have changed school start times, students are obtaining more sleep. Bedtimes remain virtually the same, but sleep is extended in the morning.

- Wilton delayed start of middle and high schools from 7:35 to 8:15 three years ago. Follow-up study shows that students are getting 35 minutes more sleep on school nights and they are not staying up later.

- Nationwide, at least 83 individual schools or districts have pushed back their start times, and more than 150 additional communities are considering the issue.

- LWV survey results related to school start times:
  - Over 70% of 7th and 8th grade and high school parents in New Canaan are dissatisfied with current school schedules.
  - Opinion on changing start times from professional staff was mixed.
  - 85% of 7th and 8th grade parents and 84% of NCHS parents agreed that it would be acceptable for extracurricular activities to start and finish later.
  - 77% of 7th, 8th grades and NCHS parents agreed that it would be acceptable for athletes to arrive later but on time for regularly scheduled games.

For further information:
Email: sleepstudy@lwvnewcanaan.org
Visit: www.sleepfoundation.org.
Obtain: "Your Guide to Healthy Sleep," from
www.nhlbi.nih.gov/health/public/sleep/healthy_sleep.htm
See the League of Women Voters' binders at the New Canaan Library reference desk.

REPORT SUMMARY

In 1997, the National Institutes of Health issued a "Working Group Report on Problem Sleepiness." While recognizing that "problem sleepiness and its consequences affect all segments of society to some extent" it singled out two groups for its report – shift workers and adolescents – because "there is evidence that the prevalence of problem sleepiness is high and increasing in these groups, with particularly serious consequences." [i]

A few years later, the American Academy of Pediatrics followed suit, establishing its own working group in conjunction with other organizations. Its report, published in the June 2005 issue of *Pediatrics*, stated that "adolescents and young adults are often excessively sleepy. This excessive sleepiness can have a profound impact on school performance, cognitive function, and mood and has been associated with other serious consequences such as increased incidence of automobile crashes." [ii]

Adolescents need nine to ten hours of sleep per night -- the same as younger children. However, surveys conducted nationwide and here in New Canaan reveal that the majority of high school students sleep less than seven hours on school nights.

This is a cause for concern on many levels. If a person receives insufficient sleep, it does not mean simply that he or she will feel more tired the next day. Sleep is not a time when we just "shut down." The body and brain are extremely busy during the night, and cutting sleep short compromises the physiological and neurological activities necessary to ensure optimal physical, emotional and mental functioning.

Both the quantity and quality of nightly sleep are important. A person cycles through two different types of sleep each night in predictable patterns. When a person wakes up earlier than the body demands, this architecture is disrupted and the person misses a significant amount of REM sleep, the stage where dreams occur and which is associated with the consolidation of learning and memory.

The body keeps track of missing sleep time. With each night of insufficient sleep, students add to a growing "sleep debt" which must be repaid. While the effects of sleep debt can be masked through temporary arousal, the underlying burden remains. Caffeine consumption, daytime napping and extended weekend sleep are all signs that adolescents are sleep deprived; these efforts to self-stimulate or catch up on sleep, while perhaps understandable and even necessary, compound the problem by making it more difficult to fall asleep at night.

Sleep debt is cumulative. By missing at least two hours of sleep each night, by Friday, these students are walking around with an accumulated ten to fifteen hours of sleep debt – the equivalent of at least a full night's sleep.

A shift to later sleep patterns is one of the most notable developmental changes as children proceed into puberty. Hormonal changes alter circadian rhythms in adolescents. The alerting cues of the biological clock, which occur in peaks and troughs throughout the day to

maintain wakefulness in the face of growing pressure from the biological sleep drive, create a situation where adolescents feel quite awake at night, even when they are severely sleep deprived. Melatonin, the hormone that induces drowsiness, is released at a later hour during adolescence. With early start times for school, adolescents are being woken up in the wrong phase of the circadian cycle, as melatonin levels are still elevated and body temperature is at its minimum, indicating a body still in sleep mode.

The world of the adolescent changes, too, which exacerbates the biological propensity for later bedtimes. A growing autonomy, greater academic responsibilities and increased opportunity for social and extracurricular activities contribute to changes in sleep patterns. The availability of electronic diversions also has an impact on sleep habits. As intrinsic biological changes and external influences intertwine, it is difficult for adolescents to fall asleep at an hour which is compatible with early wakeup times.

The resulting nightly sleep deprivation has profound consequences. From the standpoint of mental and emotional functioning, sleep deprivation cuts to the very core of what it means to be an adolescent. Developing social competence, learning to integrate emotions with thinking and planning, is the work of adolescence and sleep deprivation takes a profound toll on these capabilities. The prefrontal cortex (the part of the brain responsible for impulse control, planning and reasoning) matures during adolescence by establishing the architecture of neural pathways for the adult brain; adequate sleep is essential to this process.

Insufficient sleep has a documented impact on a variety of cognitive, emotional and physical functions. Whether it is an adolescent's ability to handle stress, combat depression, maintain alertness, consolidate new knowledge, ward off infection, drive safely or resist the allure of illicit substances, sleep is essential to daily functioning.

Experts have identified early school start times as biologically inappropriate for adolescents and a contributing factor to limited sleep time. The experience of schools that have moved to a later opening high school bell has shown that students receive more sleep: morning sleep is extended, while bedtimes remain virtually the same.

The evidence that adolescents are sleep deprived and that this has a profound impact on their well-being and development is clear and compelling. Deciding what to do about it is the more difficult challenge with the logistical issues that would accompany any start time changes, should the Board of Education decide to take on this action.

Yet, as revealed in the surveys administered by the League in 2006 to the public school community, there clearly is strong dissatisfaction with the current 7:30 start time for 7^{th} – 12^{th} graders from parents with students in those grades, as well as expressed anxiety from parents anticipating the future for their younger children. There is general satisfaction with the elementary school start times, although this satisfaction is greater at South School, which starts at 8:20 a.m., than it is for East and West, which start later. Faculty views on start time changes are mixed and show trends according to school, age group taught and length of employment.

A strong majority of parents with students at the 7:30 start time felt that moving to a later time would be acceptable in terms of starting sports and extracurricular activities later.

On June 1, 2006 the League of Women Voters of New Canaan issued a position statement that adolescent sleep deprivation is a serious public health issue that must be addressed. The League recommended that information about sleep be incorporated into educational programs in New Canaan public schools and that the school system investigate all options to implement a later starting time for 7^{th} – 12^{th} graders.

The pioneering sleep researcher, Dr. William C. Dement, says that out of all the knowledge he has accumulated in his fifty years of sleep research, "none is more important than the topic of sleep debt." [iii] Any advance in the start time would be beneficial to begin reducing the burden of sleep debt for our adolescents.

A look at start times would address one piece of the puzzle, but so too may it be worthwhile for the members of our community to consider the cultural factors which help push bedtimes for many adolescents to alarmingly late hours.

As children enter adolescence, the challenges they face intensify enormously, with the increasing academic obligations and the responsibilities and pressures that accompany a growing autonomy. As a community, we must do all we can to support the ability of our adolescents to navigate these critical years safely and successfully and establish the healthy habits that will ensure their well-being throughout their lives.

THE SCIENCE OF SLEEP

WHAT IS SLEEP?

Do we sleep simply to feel rested? While "many people view sleep as merely a 'down time' when their brain shuts off and their body rests…. research reveals that a number of vital tasks carried out during sleep help to maintain good health and enable people to function at their best."[iv] In fact, "some physiological processes actually become more active while you sleep"[v] and "the 'sleeping brain is often more significantly active than the 'awake' brain."[vi]

Sleep is an exquisitely orchestrated process of mental and physical activity that follows a specific architecture night after night. "There are several aspects of sleep including the continuity, timing, and patterning of different stages of sleep that are necessary for the restorative processes to occur." [vii] Sleep is divided into two main stages, non-REM and REM sleep, which "cycle through the night in predictable patterns. How well rested you are and how well you function depend not just on your total sleep time but on how much of the various stages of sleep you get each night."[viii]

Non-REM sleep occurs in four stages, beginning with light sleep and continuing through three other stages in which sleep becomes deeper and brain waves slow.[ix] Non-REM stages 3 and 4, also known as "slow wave" or "delta" sleep, are the deepest stages of sleep and the foundation of the body's growth and restoration. A drop in heart rate and blood pressure gives the "heart and vascular system a much-needed rest."[x] Blood supply to the brain decreases, while a greater flow goes to the muscles, which, along with an increase in cellular production during the night, provides opportunity for tissue growth and repair. Chemicals released during this stage include growth and sex hormones associated with puberty. [xi] [xii] [xiii]

Brain imaging technology reveals that "activity in parts of the brain that control emotions, decision-making processes and social interactions is drastically reduced during deep sleep, suggesting that this type of sleep may help people maintain optimal emotional and social functioning."[xiv] The length of delta sleep "increases in proportion to how long one has been awake" [xv] with longer time spent after sleep loss.

The time spent in deep sleep decreases as the night goes on; the later stages of sleep are spent predominantly in non-REM 1 and 2 and in REM sleep. [xvi]

REM sleep, so called for the "rapid eye movements" which occur behind the closed lids, cycles continuously throughout the night, beginning within 90 minutes after the person falls asleep and occurring for longer periods closer to the waking hours.[xvii] Dreams occur during REM sleep, and the "arm and leg muscles are temporarily paralyzed so that you cannot 'act out' any dreams that you may be having."[xviii] Other physiological changes include shallower breathing, increased heart rate, and a rise in blood pressure.[xix]

During REM sleep, "the brain regions used in learning and the laying down of memories" are stimulated."[xx] "Higher cortical brain functions are quite active and resemble

wakefulness."[xxi] The intense neural activity that goes on during REM sleep is believed to play an important role in the consolidation of memory and learning, by making connections to brain circuits for information acquired during the day and by "strengthening memory circuits much as lifting weights causes strengthening of muscles."[xxii] At the same time, however, the "brain cells containing norepinephrine and serotonin are inactive," suggesting that these neurotransmitters "thought to be crucial for new learning" are being replenished.[xxiii] Increased cellular production is seen during REM sleep as well, again indicating replacement of proteins broken down during the day.[xxiv]

The body needs its full percentage of REM sleep each night. With "a short night of sleep you are eliminating the long REM sleep periods that come towards morning."[xxv] If REM sleep is disrupted, then the next night "we often slip directly into REM sleep and go through extended period of REM until we 'catch up' on this stage of sleep."[xxvi]

THE DRIVE TO SLEEP

Both the quality and quantity of sleep are important. Just as the body knows to recoup disrupted stages of sleep in successive nights, so too does it keep track of missing sleep time. "The brain keeps an exact accounting of how much sleep it is owed. …We use the term 'sleep debt' because accumulated lost sleep is like a monetary debt: it must be paid back."[xxvii] Since sleep debt is cumulative, "you don't work off a large sleep debt, by getting one good night's sleep," explaining why people can "still feel just as sleepy or even sleepier than before" after getting a "full night" of sleep.[xxviii]

During the waking hours, the chemical adenosine builds up in the bloodstream, and breaks down during sleep. An accumulation of adenosine after nights of insufficient sleep may help explain this phenomenon of sleep debt; "because of such built-in molecular feedback, you can't adapt to getting less sleep than your body needs."[xxix]

Whether through the internal alerting cues of the biological clock or external stimulation, such as caffeine, an open window, or an interesting activity, the effects of sleep debt can be masked, "but this temporary arousal is a dangerous state, because sleep can overtake the brain the moment the arousal ceases or the person relaxes."[xxx]

The need to sleep "may be the most powerful biological urge"[xxxi] and the body, in fact, has a countervailing system to offset growing pressure of the sleep drive as the day progresses. The system that controls the daily rhythm of sleep and wakefulness is called the "Opponent – Process Model," so termed by Drs. William Dement and Dale Edgar during their work together at the Stanford Sleep Center in the 1980s.

The "homeostatic sleep drive," the name for the biological urge to sleep, "is continuously active, even when we are awake… and is steadily increasing"[xxxii] throughout the waking hours. Alertness is controlled by the circadian rhythms of the biological clock, which "promotes wakefulness and actively opposes sleep. . . . In contrast to sleep homeostasis, the process in our brain that fosters wakefulness and sustained alertness is not active

continuously… The push and pull of these opposing processes allows us to stay up all day and sleep all night."[xxxiii]

The biological clock "synchronizes a vast array of biochemical events in our bodies. It is the maestro conducting the complex symphony of chemical, hormonal and nerve cell activities that promote our daily fluctuations in feelings and activities."[xxxiv] A "pinhead size" collection of about 20,000 neurons located in the hypothalamus region of the brain "just above the point where the optic nerves cross, this body clock "governs functions that are synchronized with the sleep / wake cycle, including body temperature, hormone secretion, urine production, and changes in blood pressure." [xxxv] The term "circadian rhythms," derived from the Latin words for "around a day," has been used to describe this process, because of the "intricate and orderly series of psychological and physiological changes that occur approximately every 24 hours." [xxxvi]

The alerting system of the biological clock operates in peaks and troughs with its strongest pull in early evening. This explains why people may feel drowsy after eating lunch, for example, because with a dip in the clock's alerting intensity at that time, they are "feeling their accumulated sleep debt, unopposed by clock-dependent alerting."[xxxvii] Similarly, feelings of fatigue may diminish in the early evening because the biological clocks provides "a more powerful stimulation" to stay awake. The alerting process finally "permits sleep by turning off and allowing the sleep process to operate unopposed throughout the night."[xxxviii] "When darkness falls, the biological clock triggers the production of the hormone melatonin (which) makes you drowsy,… melatonin builds up in your body as the night progresses and decreases when daylight arrives."[xxxix]

The circadian system is "sensitive to light cues and social schedules… and adapts slowly to changes in sleep/wake schedules. … It adapts more easily to delays in the sleep/wake schedule rather than to advances. That is why it is naturally easier to stay up later and sleep in later on weekends."[xl] "Regularity is important for setting and stabilizing (the) internal sleep-wake biological clock." [xli]Any resetting of the biological clock can be done "only by appropriately timed cues and even then, by 1-2 hours per day at best."[xlii]

To ensure healthy sleep habits, experts emphasize the importance of setting regular sleep/wake schedules with little variation between the weeknight and weekend, and avoiding stimulation close to bedtime. "Simple activities like checking your email… have the potential to fool our bodies into delaying our biological onset of sleepiness."[xliii] It is important to "unwind and relax before going to bed… An established sleep routine breaks the connection between the psychological stressors and stimulating activities of the day and the sleep period."[xliv]

"Sufficient sleep can be defined as the amount that satisfies the homeostatic process and is not associated with daytime sleepiness. … This is analogous to the daily caloric requirement to maintain a stable weight."[xlv] According to the American Academy of Pediatrics, "sleep research data indicate that adolescents still require 9 to 10 hours of sleep per night." [xlvi]

ADOLESCENT SLEEP PATTERNS

Doctors define adolescence as the period between 13-22 years of age. [xlvii] Scientific observation has confirmed what is perhaps obvious to many parents of this age group. As children enter puberty, "the timing of sleep and wakefulness undergoes one of the most prominent behavioral changes that occur during adolescent development…. Data collected from many countries have confirmed the strong trend for later bedtimes and later rising times during the teen years."[xlviii] This is "not a novel finding," as even in 1913 scientists "noted a shift from 'vesperal' to 'matinal' sleeping during adolescence."[xlix]

The reasons for this shift to later sleep patterns are both biological and behavioral. "The interactions between physical and psychosocial domains can lead to dramatic alterations in sleep patterns and habits during adolescence."[l]

"The hormonal influences of puberty tend to shift adolescents' biological clocks,"[li] a shift referred to as "sleep phase delay." [lii] Adolescents can be characterized as "classic night owls" who experience " a troublesome kick in alertness at about the time the people around them (younger and older) are getting sleepy and going to bed." [liii]

The biological clock sets up "forbidden zones" when it's hard to fall asleep and "sleep gates" when sleep can occur more easily. [liv] "We see in many adolescents that this forbidden zone is in the evening hours. So they actually feel great at night, and for many of them, that makes it harder for them to even consider trying to go to bed earlier," Dr. Mary Carskadon observed on a PBS-TV "Frontline" special. "When people just say, 'Well, all they have to do is go to bed earlier,' well, they really can't necessarily." [lv]

In a study with college students whose sleep was limited to five hours a night, while "daytime sleepiness increased,…(and) even with restricted sleep students felt more alert in the evening, encouraging the tendency to stay up late again."[lvi]

Investigators have measured melatonin secretion as a way to observe the circadian rhythms affecting sleep and have found that "melatonin onset occurs later in adolescents, making it more difficult for them to go to sleep earlier at night. At the same time, the hormone 'turns off' later in the morning, making it harder for them to wake up early."[lvii]

Another marker of circadian "oscillation" is body temperature regulation, which rises and falls in predictable cycles, reaching its "trough" during the "peak phase of REM sleep,"[lviii] which, as noted in the previous chapter, occurs during the waning hours of sleep. Many adolescents required to rise earlier than their bodies demand, "are trying to awaken during their body temperature minimum, when their body is not prepared to be awake and active."[lix]

Consistent with the propensity towards later bedtimes in adolescence, "differences in the time of child versus adolescent spontaneous morning awakenings have also been reported… In a longitudinal study with a fixed time in bed for sleep, younger children were more likely than adolescents to spontaneously awake before 8:00 a.m."[lx]

Dr. Carksadon characterizes adolescent development as "'a handshake' between biology and behavior." [lxi] Along with the physical changes that come with puberty, the world of the adolescent is a very different one from that of a younger child, and this, too, has a significant impact on sleep patterns. "Such processes as the growing expression of autonomy, the increase in academic obligations and social opportunities, as well as the rising availability of late evening activities offered by access to telephone, television and Internet – all contribute in a significant way to the behavioral regulation of adolescent sleep patterns."[lxii]

As well, "the cognitive components of the ability to fall asleep undergo substantial changes at some point in adolescence, i.e., younger children's rumination, worry and distressing thoughts are much less likely to interfere with going to sleep than those of adolescents." [lxiii]

"An essential part of getting older is becoming more independent, more able to make decisions for oneself. Teens generally are allowed more leeway than younger children to stay up later and decide on their own sleep time," according to Dr. Dement.[lxiv] Surveys conducted by Dr. Mary Carskadon confirm this observation, with only 5% of high school students reporting bedtimes as being set by their parents. In these surveys, 44% of these students reported going to bed when they felt sleepy, while 32% of the students said they went to bed when they were finished either with homework, watching television or socializing. [lxv]

According to the 2006 Sleep in America poll, a national survey of caregivers and their children in 6^{th} – 12^{th} grades conducted by the National Sleep Foundation, "just one in five adolescents gets an optimal nine hours of sleep on school nights… the average 6th-grader sleeps an average of 8.4 hours on school nights, while a typical high school senior sleeps just 6.9 hours." In the poll, "more than half of adolescents report feeling too tired or sleepy during the day." Results also showed that "at least once a week, more than one-quarter of high school students fall asleep in school, 22% fall asleep doing homework, and 14% arrive late or miss school because they oversleep." [lxvi]

To compensate for sleepiness, the survey found that "three-quarters of adolescents report drinking at least one caffeinated beverage daily, and nearly one-third (31%) consume two or more such drinks each day." The poll found that "about one-third (31%) of adolescents take naps regularly. Their naps average 1.2 hours, well beyond the 45-minute maximum recommended so that nighttime sleep is not affected."[lxvii]

Along with inadequate sleep during the school week, the irregularity of adolescent sleep patterns is of concern to experts. A "consistent finding in the literature on adolescent sleep patterns" is "that differences between weekend and school-night sleep schedules are large for many teenagers." Evidence supports "the importance of total sleep time and sleep schedule regularity as predictors of daytime functioning." [lxviii]

Participants at a 1999 workshop on "Sleep Needs, Patterns, and Difficulties of Adolescents," which brought leading sleep researchers together with health care providers, educators and policy makers, noted that "it is not just sleep loss that is troublesome in adolescents but the enormous variation in their weekday/weekend sleep patterns. While some argued strongly

that allowing students to sleep in on weekends was essential for reducing their sleep debt, others pointed out problems" with these swings, equating it to making a time zone shift twice a week.[lxix]

Local sleep specialist Dr. Saul Rothenberg observes that "It is impossible for a person to sleep more than his body needs. If a child is sleeping late on weekends, those hours are what the body needed. The problem with sleeping late on weekends is that the biological clock is thrown off schedule even more."[lxx] Workshop participants echo this: "Sleeping late on Saturday and Sunday, however, usually fosters a later sleep onset on Sunday night." [lxxi]

THE IMPACT OF ADOLESCENT SLEEP LOSS ON HEALTH, BEHAVIOR, SAFETY, MEMORY AND LEARNING

Sleep deprivation has a negative impact on physical and mental health, social behavior and personal and public safety. Scientists now know that sleep is as critical to the health of a person as diet and exercise, and that "if one part of the body system suffers, you're likely to see consequences in other areas of your life."[lxxii] Lieutenant Jeff Dyche, Ph.D. of the Medical Service Corps of the U.S. Navy says, "The idea that if you're tough you don't need sleep is a fallacy."[lxxiii]

For adolescents, both the consequences and prevalence of sleep deprivation is the subject of widespread concern in the medical and scientific community. The National Institutes of Health identified adolescents as an at-risk population for "problem sleepiness" in a 1997 report, [lxxiv] and last year the American Academy of Pediatrics reported on the "profound negative effect" of excessive sleepiness in adolescents.[lxxv]

Brain Development during Adolescence:

The end of adolescence is marked by achieving both physical maturity and social competence. As bodies grow and become sexually mature, even more significant changes are taking place within the brain of this budding adult. Adequate sleep is essential to these developments. In a landmark study in 1999, Dr. Judith Rapoport found that the preadolescent brain undergoes a huge growth spurt of gray matter (similar to that seen in other parts of the brain during the first 18 months of life) in the frontal lobe of the brain: "the seat of 'executive functions'—planning, impulse control and reasoning."[lxxvi] "Sleep is tightly woven into healthy neurological and hormonal function"[lxxvii] as new connections are made throughout adolescence in the developing brain and especially in the pre-frontal cortex, the final area of brain development. "Social competence," a critical milestone on the way to adulthood, is described as the "integration of cognitive and emotional skills involved in the self-regulation of behavior according to learned rules, societal constraints and the pursuit of long-term goals."[lxxviii]

In his book *The Power of Sleep* Dr. Dement states:

> "In a way, teens are different people. Under the influence of a rush of hormones, the brain is being remade. Some nerve networks grow and become dominant, others shrink and atrophy. Over the course of puberty, the cerebral cortex undergoes a last great bloom of neural rewiring. Nerve connections keep changing throughout adulthood, of course, but the scale of the change during puberty is unmatched again until very old age, when neurodegeneration starts undoing the brain organization that has been built up over a lifetime." [lxxix]

Sleep deprivation and mental function:

The pre-frontal cortex is responsible for integrating cognitive and emotional processes in the brain, in other words, merging thinking and planning with emotional control.[lxxx] It is this system that is most disrupted by sleep loss in the adolescent brain, and the impact of this disruption can be seen in cognitive function and mood. This integration "underpins exactly what adolescents are dealing with every day as they try to control their feelings and behavior and make plans related to school and other responsibilities,"[lxxxi]. Sleep is essential to establishing neural pathways and equally "necessary for those pathways to work up to speed." Studies have shown that a lack of sleep "causes thinking processes to slow down,…makes it harder to focus and pay attention,…makes you more easily confused,…leads to faulty decision-making and more risk-taking,…and slows down your reaction time."[lxxxii]

Sleep deprivation has also been shown to be a factor the following:

- Difficulty initiating certain behaviors[lxxxiii]
- Involuntary napping[lxxxiv]
- Inability to concentrate of tasks that are not compelling or exciting [lxxxv]
- Increased anger [lxxxvi]
- Low tolerance for frustration [lxxxvii]
- "Impair(ed) complex performance,…lapses of attention, slowing of motor and cognitive reactions, mental mistakes, working-memory errors, time on task decrements and potentially uncontrolled sleep attacks," [lxxxviii]
- Increased negative mood, difficulties with mood regulation, irritability and mood disorders[lxxxix]
- Increased likelihood of stimulants and alcohol use[xc]

Health Implications:

Sleep Deprivation and its Impact on Mental Health:

With all of the above listed factors, it is not surprising that much attention has been focused on sleep deprivation's impact on cognitive function. However, a meta-analysis of sleep studies by researchers June Pilcher and Allen Huffcutt found the following: "Mood is

affected more by sleep deprivation than are either cognitive or physical performance.[xci] "Sleep deprivation studies have shown consistently that sleep-deprived subjects are more irritable, more volatile and more depressed than control subjects." [xcii] In addition, "tasks that simultaneously challenge cognitive and emotional processing appear to be particularly sensitive to sleep deprivation." In a study involving college students, when a postural balance test or a cognitive test was administered alone, results were mildly affected by sleep loss; however performance declined significantly when the two were administered together.[xciii]

While these effects may seem to be insignificant, it is exactly these types of simultaneous cognitive functions that form the foundation of an adolescent's successful development of social competence: "The ability to concentrate on a long-term goal or consequence while regulating emotional reactions in social situations is precisely the territory that many adolescents are struggling to navigate in their day-to-day lives. If sleep deprivation results in impairment in this domain, it may have very significant consequences." [xciv]

Italian researchers found the following: "Sleep problems…(are) positively correlated with daytime sleepiness, …increased use of psychoactive substances,…depressive mood,… and anxiety." [xcv] In addition, "sleep, or lack of it,…impacts the amount of certain neurotransmitters produced by the brain…(that) play a huge role in the body's regulation of emotions," [xcvi]

The 2006 Sleep in America poll taken by the National Sleep Foundation states: "(L)ack of sleep can cause teens to act out and succumb to feelings of anxiety, depression and hopelessness. 'Insufficient sleep not only results in difficulty with focus, attention and concentration…, but also leads to irritability and mood disorder,' says Helene Emsellem, Medical Director at the Center for Sleep and Wake Disorders in Chevy Chase, MD." [xcvii] "People who chronically suffer from a lack of sleep …are at greater risk of developing depression."[xcviii] Adolescence is a developmental period with higher risk for emotional and behavioral disorders to emerge. "Arousal, stress or distress may interfere with sleep, setting up a vicious cycle in which emotions cause lack of sleep and lack of sleep exacerbates emotions." [xcix] In fact, "subjects who showed objective evidence of sleep-onset abnormalities in adolescence were more likely to develop depressive episodes in the future (and)…subtle disturbances in sleep also may be predictive of a worse clinical course among adolescents with mood problems." [c]

Sleep deprivation is cumulative and may be the first step in an adolescent's "negative spiral" in school and social functioning. Sleep deprivation erodes mood and motivation, resulting in problems with school and social functioning, leading to stress and associated affective problems. [ci] Even the busiest adolescent is not immune to the effects of insufficient sleep. Indeed, researchers have found that "teens who are heavily involved in school and community activities…appear to be at greater risk for … (the) effects of sleepiness than those who are less involved in activities.[cii]

Sleep Deprivation and its Impact on Physical Health

In addition to the well-known effects of daytime sleepiness, fatigue, irritability and negative mood, a lack of sleep has more far-reaching and long-term detrimental effects on a person's physical health. As the conscious mind takes a break from the demands of waking hours, the body and brain undertake much of the maintenance, regulating and sustaining work needed to maintain the organism's health. And a lack of sleep thwarts completion of these necessary tasks, resulting in sub-optimal health.

- *Hormone secretion*: During sleep, the body secretes many of the hormones that regulate growth, cell repair, immune function, metabolism, and appetite.

- *Growth and cell repair*: "Growth hormone secretion peaks during sleep, so uninterrupted deep sleep is especially crucial for children and adolescents,"[ciii] so your mother's admonition to go to sleep so you could grow was not far off the mark. Deep sleep triggers more release of growth hormone, leading to physical growth, increase in muscle mass, and cellular repair.[civ] Cellular repair is critical to maintaining a healthy body. "Much of this repair is the job of growth hormone which stimulates…cell division to replace old or malfunctioning cells. The concentration of growth hormone released during the night's first period of stage 4 sleep suggests that deep sleep is important for this repair process." [cv] This cell repair is critical in developing bodies as well as in fighting errant cells that may lead to cancer. In addition, "sleep allows neurons used during waking hours to repair themselves" and "allows for greater protein production and cell repair." [cvi] Sleep's effect on the release of sex hormones ushers in puberty and promotes fertility in both males and females.[cvii] In fact, women who lack sleep are more likely to have trouble conceiving or to miscarry.[cviii]

- *Immune function*: Immune system function is closely tied to the cellular replacement that occurs most significantly during sleep. It is a widely accepted fact that sleep increases a person's resistance to disease, [cix] and there are physical reasons besides "bedrest" that this is true. "During sleep, your body creates more cytokines, cellular hormones that help the immune system fight various infections."[cx] There is growing evidence that sleep may help sustain the activity of certain immune cells and chemicals. "Natural killer cells (tumor necrosis factor (TNF) and interleukin-1) may be particularly affected by lack of sleep…Even when we are...healthy, circulating TNF naturally increases tenfold while we sleep," [cxi] "According to a recent study cited in Science News, one night's loss of sleep can reduce the number of infection-fighting immune cells in your blood by as much as 30%." [cxii] Reduced sleep can reduce the body's response to immunizations and its natural ability to fight off infections. In one study, sleep deprived volunteers produced more than 50% fewer antibodies in response the flu vaccine as well-rested volunteers.[cxiii] In other studies at Carnegie-Mellon and the University of Pennsylvania, a person's susceptibility to the cold virus was directly related to the amount and quality of sleep he had had before exposure to the virus. [cxiv]

- *Metabolism and appetite*: "Not getting enough sleep can also impact your long-term physical health. Recent studies…suggest that disrupted sleep patterns may contribute to the onset of metabolic syndrome and excess weight gain in some people." [cxv] "The current epidemic of diabetes and obesity appears to be related, at least in part, to getting chronically inadequate sleep. Evidence is growing that sleep is a powerful regulator of appetite, energy use and weight control. During sleep, the body's production of the appetite suppressor *leptin* increases, and the appetite stimulant *grehlin* decreases. Studies find that the less people sleep, the more likely they are to be overweight or obese and prefer eating foods that are higher in calories and carbohydrates." [cxvi] For many, a common consequence of sleep loss is feeling too tired to exercise, only compounding the metabolic chemistry shifts associated with sleep loss. In the 2006 *Sleep in America* study conducted by the National Sleep Foundation, 28% of adolescents report feeling this way.

  During sleep other important hormones are secreted that regulate how the body uses energy, with distinct rises and falls of blood sugar seen depending on various stages of the sleep cycle. "Not getting enough sleep overall or enough of each stage of sleep disrupts this pattern."[cxvii] One study found that "women who slept *less than 7 hours* a night were more likely to develop diabetes over time than those who slept between 7 and 8 hours a night."[cxviii]

- *Sleep deprivation and cardiovascular disease*: During sleep, your heart and blood vessels get a much-needed break from the rigors of the day. "During non-REM sleep, your heart rate and blood pressure progressively slow as you enter deeper sleep." [cxix] In spite of scattered spikes of activity during REM sleep, "overall,…sleep reduces your heart rate and blood pressure by about 10%." [cxx] With insufficient amounts of sleep, this reduction may not occur, making you more likely to experience strokes, angina, irregular heartbeat, heart attacks and congestive heart failure.[cxxi] A lack of sleep puts your body under stress and increases the circulation in the body of stress hormones such as adrenaline and cortisol. Studies have shown that individuals with sleep loss have higher blood levels of C-reactive protein, which is thought to contribute to a higher risk of developing atherosclerosis (hardening of the arteries).[cxxii] Metabolic syndrome, mentioned above, is a constellation of risk factors that can increase a person's chance of having heart disease or a stroke.[cxxiii]

- *Other factors impacting health:* In addition to the impact on cellular and hormonal function and on cardiovascular health, sleep loss can sometimes be implicated in other health conditions. Several studies "have found evidence of ADHD-like symptoms associated with sleep deprivation and some improvement in ADHD symptoms in children following treatment of sleep problems."[cxxiv] There is also a link between "sleep deprivation and increased incidence of seizures for those with seizure disorders." [cxxv] There is an increased likelihood of stimulant use, with a chemical dependence on caffeine often seen in adolescents.[cxxvi] As stated earlier in this report, 75% of adolescents report drinking at least one caffeinated beverage daily, and nearly one-third (31%) consume two or more such drinks each day."[cxxvii] One writer reports that "young people are using caffeine to compensate for chronic

> inadequate sleep."[cxxviii] In addition, "some percentage of teen substance abuse, as a method of heightening arousal or decreasing the effects of anxiety and depressions, may be attributable to the direct and indirect effects of sleep deprivation."[cxxix]

A pattern of sleep loss established during these formative years of adolescence may set the stage for serious health implications down the road.

Behavior:

In addition to the impacts on mental functioning mentioned above, sleep deprivation can be directly implicated in the following: daytime sleepiness, tiredness (a general feeling of fatigue that makes it difficult to initiate or sustain certain activities), unstable mood (overreacting to situations), diminished impulse control,[cxxx] memory lapses, and reduced athletic ability (speed and endurance).[cxxxi]

Observable behaviors that are reported by adolescents to be a direct result of sleep loss are the following:[cxxxii]

- Falling asleep at school (18%)
- Falling asleep during homework (22%)
- Trouble getting along with family (24%)
- Cranky/irritable during the day (28%)
- Too tired to exercise (21%)
- Drink 2+ caffeinated beverages/day (36%)
- Take at least 2 naps/week (38%)

Across the research, a person's mood is seen to be the most often cited, observable bellwether of sleep deprivation. One significant finding is that a "strong association was found between negative moods and more-pronounced sleep-related issues. Among those adolescents who say they're unhappy or tense most often, 73% feel they don't get enough sleep at night and 59% are too sleepy during the day."[cxxxiii] Other studies have found "significant increases in complaints of depressed mood…in surveys of adolescents who… report more than 2-hour differences between school night and weekend bedtimes."[cxxxiv]

As our adolescents strive to interpret and negotiate the challenges and relationships in their lives life, embarking on this complex task with anything less than their full capacity holds both individual and societal consequences.

Personal Safety:

Being well-rested is a prerequisite for personal safety. The two main factors of sleep loss that are exhibited with varying degrees of sleep loss are lapses in attention (ranging from feeling drowsy to outright involuntary nodding off, a.k.a. "sleep attacks") and delayed response time at critical moments during waking hours. These manifestations of sleep debt compromise the personal safety of the individual and of those around him with "increased risk of unintentional injuries and death."[cxxxv] Sleep deprivation is known to increase accidents, memory lapses, injuries, and time needed to process information and to decrease athletic ability (in terms of speed and endurance) and alertness.[cxxxvi] A sleep-deprived adolescent has multiple opportunities during a typical day for serious safety breaches to occur.

- *Drowsy driving*: Driving while drowsy is not an experience unique to adolescents, but it is a serious public safety problem. "Drowsy driving is becoming a national epidemic, according to some experts, even more problematic and more common than drunk driving."[cxxxvii] Unlike driving under the influence of alcohol, there is no test for drowsiness. "The only hope for saving lives is if people recognize that drowsiness (behind the wheel) is an extreme danger signal."[cxxxviii] It is thought that about 1 million crashes in the U.S. each year (1/6 of the total) are caused by driver inattention or attention lapses. "Sleep deprivation and fatigue make such lapses of attention much more likely to occur."[cxxxix] Dr. Kotch, Director of the Danbury Hospital Sleep Center, states: "It has been documented that being awake for 18 hours straight is the equivalent of having a .5 blood alcohol content" which is legally drunk in some states.[cxl] Combined with sleep loss, the effect of any amount alcohol is amplified greatly.[cxli]

- *Falling asleep at the wheel:* If we carry a sleep debt, our biological drive to sleep may cause involuntary napping, whether at home, in school or behind the wheel. Our wakefulness becomes unstable; we take rapid and involuntary "microsleeps". Reaction times get longer. "A one second lapse in reaction time while driving a car at 60 m.p.h. translates into 88 feet."[cxlii] The U.S. Department of Commerce reports that in 1989, "motor vehicle accidents were the second largest single cause of death in persons aged 15-24 years in the U.S.,[cxliii] not surprising considering the youth and inexperience of the drivers. Combined with sleep deprivation, that inexperience can rapidly become deadly. 27% of adolescents reported that, in 2005, they had an accident or near-accident because of drowsiness while driving.[cxliv] Statistics from the National Highway Traffic Safety Administration (NHSTA) state that "young people (between 16 and 20 years old) were the single age group most likely to be involved in a fall-asleep crash."[cxlv] Further, Dr. Mark Mahowald, a sleep expert, says "Fall-asleep crashes probably kill more Americans under the age of twenty-five than alcohol-related accidents," and if one adds driver inattention as a factor, there are probably an additional million non-fatal crashes each year.[cxlvi] A statewide study in North Carolina found that "young drivers age 25 or under cause more than one-half (55%) of fall-asleep crashes,"[cxlvii] identifying drivers' lack of sleep as a significant concern in highway safety. "Compared with sleeping eight hours or more each night,

sleeping six to seven hours was associated with a 1.8 times higher risk for involvement in a sleep-related crash…and sleeping fewer than five hours per night invoked a 4.5 times higher risk."[cxlviii] According to Dr. O'Malley of the Norwalk Sleep Disorders Clinic, the time of most fall-asleep crashes is from 5 a.m.until 8 a.m., with the greatest frequency between 7 a.m. to 8 a.m.[cxlix]

- *On-the-job accidents:* In addition to the often dire results of falling asleep at the wheel, sleep loss leaves its imprint on the day-to-day life of adolescents. Dr. Carl Hunt, of the National Institutes of Health's National Center on Sleep Disorders Research bluntly states: "A tired child is an accident waiting to happen." [cl] The National Institute for Occupational Safety and Health (NIOSH) estimates that 231,000 workers under 18 years old are injured on the job every year.[cli] A report issued by the National Consumer League reports that between 70-80% of all teens work for pay during high school and estimates that "every 30 seconds a teen worker is injured on the job and that one teen dies due to workplace injury every 5 days."[clii] With slower reaction times, climbing scaffolding on a construction site, lifeguarding at a pool, slicing meat at a deli or handling a heavy mower can turn an adolescent's summer job into a tragedy. With the decrease in alertness, physical speed and endurance that accompanies sleep loss, a miscalculation on the football field, the balance beam or a downhill ski run can result in serious injury.

Sleep loss' attendant slower reaction times and lapses of attention are serious public safety concerns. At risk are not only the person with the sleep debt, but also that person's passengers, co-workers, classmates, fellow athletes and other drivers on the road. Nothing can replace sleep in repaying the debt. Cold air, loud music, even stimulants will not keep a person awake if the sleep debt is too large. The only thing that will work is sleep. To require a person to function on less sleep that he needs is to condone a danger to that person and to public safety.

Learning:

"Sleep is not just to refresh, but a critical time for both memory and learning." [cliii]

The old adage to "sleep on it" when working on a challenging problem draws on anecdotal evidence that only recently has been confirmed by scientific research showing that sleep is essential to all stages and types of memory. When we learn something new, neurons in our brain form connections via electrical stimulation that alters the involved neurons' protein structure, forming networks throughout the brain that serve as the "filing cabinets in which every memory is stored, and from which every idea is formed." [cliv] Following a period of study, PET scans of the brain indicate increased metabolic activity during REM sleep, and people who are deprived of REM sleep find it difficult to recall recently learned material.[clv]

Neurologists divide memory into two categories: declarative and non-declarative. Declarative memory is that which we usually associate most directly with learning; it is the "consciously accessible memories of fact-based information."[clvi] Non-declarative memory

is that associated with the "how" of doing things: procedural memory of how to perform actions, habits and other skills, many of them motor-function-based.[clvii] In addition, memory has two distinct stages: consolidation and enhancement. Consolidation takes place when learned material becomes "increasingly resistant to interference from competing or disrupting factors," which takes place mostly during waking hours. Memory enhancement, which occurs almost exclusively during sleep, is when lost memories are restored and brought to bear on newly learned material, producing additional, new learning.[clviii]

Sleep debt exacts a heavy toll on memory consolidation. Less than optimal amounts of both non-REM and REM sleep after learning a new task show declines in performance immediately after the training and several days later, even after sleep and alertness are restored.[clix] Tests of motor skills require adequate amounts of Stage 2 (non-REM) sleep. Cognitive tasks that require new solutions to problems require adequate REM sleep. Dr. Carlyle Smith, Professor of Psychology at Trent University in Ontario, found that performance on a task requiring memory of complex rules deteriorates 20% to 30% if people do not sleep the night after learning the rules.[clx] During REM sleep the brain has been found to show electrical activity that repeatedly mirrors activity shown during waking learning sessions, as if the brain is rehearsing the new learning over and over again at night. Following adequate REM sleep, performance on cognitive tasks has been shown to improve 44%; with inadequate REM sleep, performance declined 10%.[clxi] In studies, volunteers who slept 8 hours consistently outperformed those who slept only 6 or 7 hours, with the amount of improvement directly tied to how long they slept. Other studies indicate that the "benefits of training for mentally challenging tasks are maximized after a good night's sleep, rather than immediately following the training or after sleeping for a short period overnight."[clxii]

Adequate sleep is important not only for the memorization of facts or procedures, but is "a necessity for the consolidation of human procedural skills, being able to restore previously decayed memory traces as well as trigger additional learning and thus improve…performance without the need for further practice."[clxiii] In a study conducted on rats' brains and learning activities at Massachusetts Institute of Technology, researchers found that "the rat's brain is just like a human's—working hard while the body sleeps—to process everything that happened during wakefulness."[clxiv] Sleep is "most crucial for memory. Not just remembering things but gaining insight and understanding."[clxv] This enhancement of memory, bringing past memories to bear on new ones, in novel and seemingly serendipitous relationships, is critical to creative thinking and innovative problem-solving. "The idea that you could learn something new, or gain some novel insight, as a consequence of sleeping on it, is, what we think of, actually, as a primary function of sleep," says Dr. Allen Pack, head of the University of Pennsylvania Sleep Center.[clxvi] Scientific research has confirmed this idea, with several studies of children reporting "decrements in verbal creativity, attention and psychomotor performance following either sleep restriction or sleep deprivation," indicating that "cognitive flexibility and abstract reasoning abilities may be improved" with adequate sleep.[clxvii]

Inadequate sleep has definite consequences on all kinds of learning. In scientific studies, David Dinges, a professor and chief of the the Division of Sleep and Chronobiology of the University of Pennsylvania School of Medicine, found "a significant change in the learning

curve associated with sleep loss."[clxviii] Subjects getting 8 hours of sleep a night performed better and better each day on the learned task. Those getting 6 hours of sleep a night showed no learning curve associated with the task, while those getting 4 hours each night showed a negative learning curve. Dinges concluded that "learning itself—that is, the ability to acquire information, retain it, and then use it repeatedly—is altered by sleep restriction…Even though young people may say they are tired, they can't tell how impaired they are."[clxix]

Educators now recognize that there are many types of learners in their classrooms. Sleep restriction has a scientifically documented impact on at least three types.

- Motor learning: Sleep deprivation results in memory decrement of learned motor skills. A night of sufficient sleep "can trigger significant performance improvements in speed and accuracy."

- Visual/Perceptual learning: While visual learning retention does not benefit from 4-12 hours wake time following a learning session, it improves significantly after a night of adequate sleep.

- Auditory learning: "Regardless of whether subjects trained in the morning or evening, delayed performance improvements developed only across a night of sleep and not across similar waking periods."[clxx]

While the research demonstrating the negative impact of inadequate sleep on memory and learning is compelling, it is less clear on its impact on students' grades. However, a Harris Poll conducted in 2002 of 2,308 high school students as part of the MetLife Survey of the American Teacher series states conclusively, "While it is important to remember that a statistical correlation does not establish cause and effect, the evidence that sleep deprivation adversely affects the performance of millions of high school students is very strong."[clxxi]

The difficulty of finding a causal relationship between sleep and grades is due in part to the facts that studies evaluating this issue rely on self-reporting of grades and amount of sleep by study participants and that many uncontrollable variables come into play in how a student's performance may be reflected in his grades. However, in a study conducted by Dr. Jeff Dyche of the United States Navy in a highly-controlled academic environment, test scores with two additional hours of "rack time," the time required for the recruits to be in bed, were found to be remarkably higher.

Dr. Dyche is participating in numerous studies of sleep at our nation's service academies and did this particular research at the Navy's only "boot camp," the Recruit Training Command Center (RTC) in North Chicago. In addition to the physical drill and military training, there is an intensive academic environment over the 8-week training session, with exams every other Friday on such subjects as history, science, and military law. 700-800 sailors (average age: 18) graduate from the RTC each week. Rack time had been 2200 to 0400 hours (10 p.m. to 4 a.m.) for a generation prior to the study. In 2002 the Navy added one hour to the rack time, from 2100 to 0400 hours, and asked Dr. Dyche to assess the

change. What he found was that the earlier bedtime was wasted; the recruits were lying in bed awake, unable to go to sleep until later, following typical adolescent circadian rhythms.

Based on Dyche's findings, the Admiral changed the rack time to 2200-0600 hours. Following this change, the average test scores showed a significant increase, jumping to 4.28 in 2003, up from 3.97 in 2000 and 3.94 in 2001, with no discernable difference in entrance aptitude test scores across the three years. Significantly, individual recruits' best scores increased to close to 4.7 in 2003 whereas the best performers of both previous years had been close to 4.1. As an added benefit, attrition was cut in half and the number of sick calls was reduced by 70%. [clxxii] With the large numbers of recruits studied and the high degree of control of other variables at the RTC, these findings show clearly that reducing the sleep debt can improve academic performance.

There is a strong correlation between adequate sleep and better grades in school, but too many variables exist for sleep to be called a causative factor for good grades. In an analysis of 14 scientific studies looking at the issue (35,199 total participants ages 8-42, from 1986-2001), Wolfson and Carskadon found the "findings strongly indicate that self-reported shortened sleep time, erratic sleep/wake schedules, late bed and rise times and poor sleep quality are negatively associated with academic performance for adolescents from middle school through the college years."[clxxiii]

Research from 3120 high school students in New England reported that "adolescents with self-reported higher grades reported significantly longer and more regular sleep/wake schedules…. on school nights than did students with lower grades--…These differences distinguished students reporting mostly B's or better from those reporting C's or worse." [clxxiv] This information is corroborated by a study of 185 college freshmen (randomly selected, no age/gender bias): "long sleepers (> or = 9 hours/night) reported significantly higher GPAs than did short-sleepers (< or = 6 hours/night), GPA 3.24 vs. 2.74 respectively." [clxxv] The National Sleep Foundation 2006 Sleep in America poll key findings states: "80% of adolescents who get an optimal amount of sleep say they're achieving A's and B's in school, while adolescents who get insufficient amounts of sleep are more likely than their peers to get lower grades."[clxxvi] It is not difficult to understand why achievement in school is more difficult for these students. Their sleep debt impacts their lives at home and school. Citing again the 2006 Sleep in America Poll: 28% of high school students report falling asleep in school; 22% fall asleep doing homework; and 14% arrive late or miss school because they oversleep.[clxxvii]

What We Found in New Canaan:

NCPS COMMUNITY SURVEY of SLEEP HABITS AND SCHOOL START TIMES

In February of 2006, the League of Women Voters of New Canaan administered surveys about sleep habits and school start time opinions to students in grades 4, 6, 8, 10 and 12, to all New Canaan public school parents and professional staff. In developing the surveys, the League kept in mind three main questions:

- Are our children getting enough sleep?
- Are there concerns about our children's health, well-being and ability to achieve their full learning potential?
- How does our community feel about school start times?

For the student survey, the League adapted a questionnaire that Dr. Mary Carskadon of Brown University had used nationwide. For the parents and professional staff, the League consulted with Dr. Kurt Schlichting of Fairfield University in designing the questionnaire.

While the student surveys were administered in the classroom, the parent and staff surveys were conducted online through the services of Zarca Interactive, an online survey company. Administering the survey online assured quality control and enabled the League to accept only one response per household.

Dr. Schlichting compiled the data from the student surveys and analyzed the results of all three groups.

The response rates were extraordinary, especially for the parent survey, which required active participation on the part of the parents. In order to participate, parents had to log in with a unique ID and password that they had received via postcard. The parent response rate was 27%, representing 31% of NCPS students. Having received an email invitation, 36% of the professional staff participated. 76% of students in 4^{th}, 6^{th}, 8^{th}, 10^{th} and 12^{th} grades took the paper survey in the classroom.

KEY FINDINGS OF THE PARENT SURVEY:

- Younger students get sufficient sleep. The vast majority of K-4 children get 9-10 hours of sleep on school nights.

- Older students are sleep deprived. About 85% of 7^{th} and 8^{th} graders get 8 hours or less, and 77% of 9^{th} -12^{th} graders get 7 hours or less (about one quarter of them get 6 hours). These students are accumulating a "sleep debt" of 10-15 hours per week. Signs that children are trying to pay back this debt are in their napping on weekdays (17% of high school students), sleeping longer on weekends (96%), and difficulty waking for school (59%).

- Bedtimes shift significantly later as students get older. K-4 bedtime is 8:00-9:00, 5th and 6th – 9:00-10:00, 7th and 8th – 9:30-10:30. 71% of high schoolers go to bed after 10:30. A third go to bed at 11 or later.

- Several factors contribute to the differences in bedtimes. The most frequently mentioned factors in the open-ended section of the survey were homework load, body clock changes and sports and extra-curricular activities.

- Health, stress levels and performance are impacted by lack of sleep. 56% of parents report that lack of sleep causes health problems for their child. 74% report that it causes stress. 59% of all parents felt that their child would do better in school if he/she got more sleep (74% of just high school parents).

- Shifting extracurricular and sports schedules would be acceptable. 85% of 7th and 8th grade parents agreed, and 84% of high school parents agreed that it would be acceptable for extracurricular activities to start and finish later if there were a later school start time. 77% of 7th -12th grade parents agreed that it would be acceptable for our athletes to arrive later, but on time, for regularly scheduled games.

- There is general satisfaction with the current school schedules for younger children. Of the elementary schools, South parents are the most satisfied.

- There is significant dissatisfaction with older children's current school schedules. 72% of parents grade 7 through 12 are dissatisfied. (Almost ½ of high school parents *strongly* disagreed with the statement that they are satisfied with their current school schedules.)

- Parents of older children agree that the amount of sleep their children are getting is insufficient (68% of 7th and 8th grade parents, 78% of high school parents). In an effort to provide more sleep for their children, 44% of high school parents always or often drive their children to school.

At the end of the survey, parents were offered the opportunity to give brief comments about the issue of sleep needs and school start times. 378 out of 620 participants chose to add comments. Below are some excerpts providing a flavor of the responses, illuminating some of the issues on parents' minds. The most frequent observations fell into the following categories:

a. factors affecting late bedtimes;
b. impact of sleep patterns;
c. start time issues.

a. Factors affecting late bedtimes

Body Clock (55 mentions)

> "Teens simply cannot go to bed as easily as younger children and have more trouble waking up."
>
> "My high schoolers are not remotely tired at 10pm, when I wish they would go to bed."
>
> "She cannot fall asleep before 10:30pm, so simply getting her to bed earlier does not help."
>
> "I am very surprised to see my 13-year-old having such difficulty waking up in the morning. As a young child, he was a very early riser."
>
> "My younger ones are usually up in the morning ready to go. They get a lot of sleep since I can regulate what time they go to sleep."

Homework (62)

> "Lack of sleep has to do with the amount of homework assigned to the students."
>
> "With the huge homework load my children cannot make up sleep by going to bed any earlier."
>
> "Since the homework given is excessive on most days, there is not a lot of downtime for the kids which is why I think they are staying up later."

Activities (32)

> "High schoolers certainly are not getting enough sleep with school starting so early and activities going late into the night."
>
> "They suffer terribly from lack of sleep in an attempt to maintain their academic standing and participate in sports."
>
> "When athletes get home, they are hungry and charged-up. Then homework to finish so they're up late and often have difficulty falling asleep, therefore, greater difficulty getting up in the morning."

Parental Controls (14)

> "Parents need to take responsibility for their children and their schedules. We have noticed many parents that allow their children (regardless of age) to set their own bedtime hours."
>
> "Parents who are concerned about the quantity of sleep their children are getting would do well to examine the depth and breadth of their offspring's extracurricular activities and make adjustments accordingly."

b. Impact of sleep patterns

Academic performance (52)

> "These are such important years academically and children going through puberty need the extra sleep time in order to function at their highest level."
>
> "I have noticed a drop off in school performance in my 8th grade student due in large measure to constant fatigue."
>
> "She falls asleep at some point in class most days."
>
> "What teenager is awake and ready to concentrate in honors classes at 7:30am?"
>
> "With a 9:05 start time, my kids have been awake for almost 3 hours; by 2:00 they start to crash when they should still be alert for instruction."

Well-being (23)

> "We ask our teenagers to perform at very high levels, and then make it more stressful for them to achieve these goals by forcing them to start their long days at such an early hour."
>
> "As a parent and pediatrician, I can state that the majority of teens require more sleep than they get. Like adults, they can function, but the frequent fatigue does affect performance (mildly) and adds to the stress of the workload."
>
> "My children are like the walking dead during the school week. On the weekends, they come to life, and are much happier."

Health (14)

> "Our oldest daughter who graduated from NCHS last June suffered terribly from lack of sleep. She got colds and flus way too often to be normal."
>
> "As a middle school teacher, I see too many children start the day extremely tired and end up with health issues."

c. Start time issues

Transportation (30)

> "It appears as if the bus scheduling is the tail wagging the dog of school start times."
>
> "No one's child, regardless of age, should be outside waiting for the bus or walking to or from school in the dark."

Afternoon activities
Elementary(16)

> "By the time my kindergartner gets off the bus, it's almost 4:00, which leaves very little time for playing outside - which to me is almost as important as sleep!"
>
> "The elementary schools should ALL begin early, so the kids are allowed after school down time before bed."

Afternoon activities
Saxe, HS
Activities can be accommodated with adjusted start times. (18)

> "I do not think high school athletic schedules should dictate the start times for all schools."
>
> "There is no need to assume that the athletic programs would suffer."
>
> "The end time of 2:00 is much too early to have a bored preteen / teenager sitting around the house."

Adjusting start times creates problems. (26)

> "Later start times will significantly curtail our kids' outdoor after school activities."
>
> "If the high school starts later, all the many activities the kids are involved with will run later, and they will be doing homework even later than they do now."
>
> "Changing the start time interferes with interscholastic athletic activities."
>
> "They enjoy the extra time in the afternoon for sports, music, homework, after school clubs and socializing"

Concern of K-6 parents about 7:30 start time for adolescents (46)

> "I am very concerned how our family will adapt next year when my daughter goes into 7th. I feel that her stress will increase."
>
> "Although I do not have children in the older grades yet, I am very concerned about what lies ahead. I do think the school start times for the older children are too early. It is easier to put younger children to bed for an earlier start."

KEY FINDINGS OF THE STUDENT SURVEY:

Results of the student survey corroborated those of the parent survey.

- Students obtain significantly fewer hours of sleep on school nights as they get older. 4th graders report an average of 10 hours of sleep on school nights. 12th graders report an average of 6.7 hours of sleep on school nights.
- Bedtimes become much later as students get older. Students in 10th and 12th grades report going to bed even later than their parents reported (56 % of 12th graders report bedtime after11pm).
- Daytime sleepiness is "more than a little problem" for more than 1/3 of kids in 8th grade and up.
- More kids are napping than parents reported, older kids more frequently than younger kids: 55% of 10th graders nap sometimes, 64% of 12th graders.

- There is an inconclusive correlation between sleep and grades shown for 10th and12th graders, but for 8th graders a positive correlation is evident:
  - ** 66% of those getting 7 hr. or less sleep/night report getting A's or A's & B's;
  - ** 76% of those getting 7-8 hrs/night report getting A's or A's & B's; and
  - ** 86% of those getting 8-9 hrs/night report getting A's or A's & B's;

KEY FINDINGS OF THE PROFESSIONAL STAFF SURVEY:

Regarding stress and fatigue:
Fewest signs of stress and fatigue are seen at the 8:15/8:20 starting schools, and 45% of staff at the 7:30 starting schools feel that student stress and fatigue would be reduced with a later start time. 40% of the 9:05 starting staff feel that an earlier start time would reduce stress.

Regarding mental alertness:
Staff at schools starting at the middle tier (8:15/8:20) see greater mental alertness. 40% of staff at the 7:30 starting schools feel that there would be some improvement in alertness with a later start. 53% of staff at the 9:05 starting schools feel that an earlier start would improve mental alertness.

Regarding extracurricular activities, extra help and homework, there is consensus among staff that early start times provide more time and the least interference.

Regarding start time preference:
Staff provided mixed views on their start time preference. When asked if a change in start time is preferred, the high school and 7th and 8th grade staff is split, 41% yes, 44% no. Once broken out between the schools, however, the high school staff prefers no change by a relatively small margin (46% vs. 36%) and the upper division staff at Saxe overwhelmingly does prefer a change (71% vs. 24%).

The surveys provided the League with solid information on which it could base its position statement about adolescent sleep and school start times. New Canaan adolescents are, indeed, sleep deprived, with high schoolers missing 2 to 3 hours of sleep per night. This accumulates a sleep debt of 10 to 15 hours every week, week after week during the school year. Most parents are aware of the problem of sleep deprivation and are concerned about their children's health, well-being and ability to achieve their full learning potential. While the staff has mixed views about changing start times, an overwhelming majority of parents showed dissatisfaction with the 7:30 start time.

Printouts of the data from the Parent, Faculty and Student surveys are available in the New Canaan Public Library and the NCPS Central Office.

PERSPECTIVES ON SCHOOL START TIMES

A number of authorities have discussed the relationship between early school start times and adolescent sleep patterns. The NIH in its "Report on Problem Sleepiness" stated that the adolescents' "sleep phase delay is in direct conflict with early school start times, which form an uncontrollable and nonnegotiable aspect of a child's daily program."[clxxviii]

The June 2005 issue of *Pediatrics* contained the results of the working group's report, which stated that "early high school start time is a significant, externally imposed constraint on teenagers' sleep/wake schedules; for most adolescents, waking up to go to school is neither spontaneous nor negotiable."

The issue also carried a study on "The Impact of School Daily Schedule on Adolescent Sleep," which said, "the results of this study demonstrated that current high school start times contribute to sleep deprivation among adolescents." [clxxix] The researchers reported that "all students performed better in the afternoon. Students in early morning classes reported being wearier, being less alert, and having to expend greater effort." [clxxx]

Dr. Carskadon believes that "if a delay in circadian phase is related to adolescent development, then requiring older adolescents to attend school and take part in intellectually meaningful endeavors in the early morning may be biologically inappropriate." [clxxxi] Data which indicated rapid sleep onsets, with REM sleep in some students, in sleep latency tests given at 8:30 a.m. to tenth graders starting school at 7:20 a.m., "are more indicative of a brain ready to be asleep than to be awake." [clxxxii] Such findings, along with recordings of elevated melatonin levels in adolescents during early morning school hours, suggest that "it is not at all unlikely that teenagers are being asked to be awake when the circadian system is in its nocturnal mode. The students may be at school, but their brains are at home on their pillows." [clxxxiii]

In Connecticut, a number of organizations have issued position papers on or related to the subject of school start times.

In January 2003, the Connecticut State Board of Education issued a "Position Statement on Time," which included the statement that "districts must take into consideration research that indicates that different age groups learn best at different times of the day. While adolescents are more alert later in the day, younger children typically are more alert in the early morning." [clxxxiv]

Also in 2003, the Connecticut PTA issued a position on "Teen Sleep Deprivation and Late School Start Time" that "advocates for local Boards of Education to devise a plan to implement a later school starting time for adolescents." [clxxxv]

The Connecticut Thoracic Society, the medical section of the American Lung Association of Connecticut under which sleep specialists are grouped, issued a position paper entitled "Later School Start Times for Teens: Improving Teen Health, Safety and Academic

Performance" which stated that "school start times are not in alignment with this shifted body clock" of adolescents. [clxxxvi]

In the spring of 2006, the League of Women Voters of Connecticut, based on a vote of its members, announced that the League "supports policies and practices that facilitate the alignment of school start times with adolescent sleep patterns." In its position statement, the League recommended that no middle or high school students start school or receive instruction before 8 a.m.[clxxxvii]

Changing Start Times: A Status Review

The move to later start times for adolescents is gaining momentum across the country. Information collected by the National Sleep Foundation indicates that schools in at least 26 states have changed times; and debate or review is underway in nearly every one of the fifty states.

On its website, the NSF offers case studies of the experiences of five towns that have made changes, to give other communities a behind the scenes look at the process. These reports, while largely anecdotal, give a sense of the issues affecting these districts and the results of the changes. These stories include districts with substantially different profiles – urban Denver, CO, the large suburban districts of Arlington, VA and Fayette County, KY, the smaller suburb of Wilton, CT and a small town in Kentucky. The solutions these communities adopted vary as well. [clxxxviii]

While hard data on the impact of start time changes is not substantial, follow up studies conducted by other researchers of start time changes in Minneapolis, MN and Wilton do provide insight.

In Minneapolis, where high school start times were changed from 7:15 a.m. to 8:40 a.m. in 1997, "many parents and administrators expressed a fear that students would merely use the later morning start time as an excuse to stay up an hour later on school nights. The data, however, show that this did not happen. Students continued to go to bed at the same time (approximately 15 minutes before 11 p.m.)" [clxxxix] The start time change "has been the single most significant thing we have done recently to improve student morale and attitudes," according to Kenneth Dragseth, superintendent of schools in Edina, MN, a suburb of Minneapolis. [cxc]

In these Minnesota schools, "a majority of teachers reported that a greater number of students were more alert during the first two school periods than they had been with an earlier start time. Slightly more than half said they saw fewer students sleeping at their desks." [cxci] Comparing these schools to districts with earlier start times, the students with a later opening bell reported receiving an hour more sleep, and "also reported less overall sleepiness, less daytime sleepiness, and less depression, as well as higher grades than their peers in the other schools." [cxcii]

Students in Wilton, which moved the start time for grades 6- 12 from 7:35 a.m. to 8:15 a.m. in 2003, are also getting more sleep each night. School night bedtimes have remained virtually the same (average time 10:52 p.m. before the change; 10:58 p.m. afterwards). Students gained 40 minutes more sleep a night, as wakeup times moved from an average 6:13 a.m. to 6:53 a.m. after the change. [cxciii]

In Wilton, daytime sleepiness has trended downward from 42% to 30% of students reporting "more than a little problem" with daytime sleepiness, but "suggesting that significant sleep deprivation was still present." [cxciv]

Medical experts agree that any reduction of sleep debt is a positive step,[cxcv] and even 40 minutes more sleep a night for the Wilton students seem to have made a difference. Dr. Gary Richards, Superintendent of Wilton Public Schools, states:

> "The Wilton Public Schools have three full years of experience with later school start times for students in grades 6-12. The data from the follow-up study, conducted by the Sleep Disorders Center at Norwalk Hospital, suggest that our students are getting additional sleep each night. The self-reported data on grades indicates a positive trend and an increased number of students report that they are less sleepy during the school day."[cxcvi]

According to the report by the National Sleep Foundation, "teachers (in Wilton) recognized a change in student behavior: they were more awake, had better attitudes, and were overall more pleasant to work with. Parents also reported changes in their kids' attitudes, and became increasingly supportive as they adjusted to the new routines." [cxcvii]

In a recent email communication to a New Canaan sleep study group member, the chair of Wilton's Board of Education, responding to an inquiry on how the town has adjusted to the change, observed that it has "been a non-issue," with no "new developments" having been brought forth to the BOE in well over a year. In encouraging the League to move forward with its work, the chair concluded, "Your students will definitely benefit!" [cxcviii]

In Connecticut, both Wilton and Fairfield have changed to later start times for adolescents, and other communities are in various stages of review. Based on conversations initiated by New Canaan Study Group members with people in other communities and information provided by the Connecticut Thoracic Society, it is known that at least fourteen other towns have been involved in discussions on the issue, to varying degrees.

Among the more intensive reviews, West Hartford established a committee three years ago, but has reached no decision. Old Lyme developed a pilot program to affect start time changes, but has tabled its implementation. New Britain's school superintendent deemed a delay not feasible.

In Westport, where a start time committee of school personnel issued a report in 1994, no decision has been made, according to school superintendent Dr. Elliot Landon in comments made at a public forum in New Canaan sponsored by the League of Women Voters. At this

forum, Dr. Landon said that while he agreed that adolescents "were not sleeping enough," the issue was complicated and there was no "one-dimensional solution."

Also appearing at the forum with Dr. Landon was Clive R. Belfield, who had provided Westport with a report entitled "Literature and Evidence Review: The Effect of School Starting Times on Educational Outcomes" in 2003. In this report, Belfield stated that key findings from the research indicated that "the link between a lack of sleep and impaired general cognitive capacities is strong and compelling; More sleep is associated with higher educational performance, but the evidence is correlational and inferential; a causal link has not been established; and information on the link between school starting times, sleep and educational performance is modest. Based on the few studies available, earlier school starting times are likely to be associated with less sleep and less sleep may be correlated with lower educational performance." [cxcix]

A recent PTC meeting Central Middle School in Greenwich on the subject of adolescent sleep patterns and school start times received considerable media attention, including both an article and a follow up editorial in the "Greenwich Time" as well as frequent mention on WCBS Radio, which reaches the tri-state audience. The League of Women Voters of Greenwich and a committed group of parents are actively pursuing the issue in that town.

League of Women Voters New Canaan
Adolescent Sleep Needs and School Start Times Committee

Please contact the Sleep Study Committee for additional information or community presentations about this report at sleepstudy@lwvnewcanaan.org.

Thank you,
The LWVNC Sleep Study Committee

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[cxcv] O'Malley, Edward and Jonathan Fine. Presentations at open meeting of LWV New Canaan at New Canaan Library, Lamb Room; New Canaan, CT on 11/15/04.

[cxcvi] Richards, G. e-mail to Shelby Cromwell, LWVNC Sleep Study committee member, on 6/27/06.

[cxcvii] www.sleepfoundation.org/hottopics/index.php?secid=18&id=314

[cxcviii] Bruschi, Susan, e-mail to Sue Stone, LWVNC Sleep Study Committee chair, on 4/27/06.

[cxcix] Belfield, Clive. Presentation at open meeting of LWV of New Canaan, held at New Canaan Library, Lamb Room; New Canaan, CT on 1/31/05, p. i.

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Belfield, Clive. Presentation at open meeting of LWV of New Canaan, held at New Canaan Library, Lamb Room; New Canaan, CT on 1/31/05. Dr. Belfield is an economist who performed a statistical analysis of research concerning adolescent sleep loss for the Westport, CT school district. This meeting was taped and broadcast on New Canaan Public Access TV.

Dyche, Jeffrey. Presentation at open meeting of LWV of New Canaan, held at New Canaan Library, Lamb Room; New Canaan, CT on 4/27/05. Dr. Dyche is an Assistant Professor at the U.S. Air Force Academy and serves in the Medical Service Corps for the U.S. Navy. He studied sleep patterns and the academic performance of recruits at the Recruit Training Command at the Great Lakes Naval Training Base before and after a change in "rack time" for the center.

O'Malley, Edward and Jonathan Fine. Presentations at open meeting of LWV New Canaan at New Canaan Library, Lamb Room; New Canaan, CT on 11/15/04.
Drs. O'Malley and Fine are on the staff at Norwalk Hospital, Norwalk, CT and are directors of the Sleep Disorders Clinic at the hospital. They studied the sleep patterns of adolescents in Wilton, CT before and after a change to a later start time for Wilton High School.

O'Malley, Edward. Presentation at open meeting of LWV New Canaan at New Canaan Library, Lamb Room; New Canaan, CT on 4/27/05. This was a condensed version of Dr. O'Malley's presentation on 11/15/04. Due to technical difficulties, the earlier meeting could not be videotaped for New Canaan Public Access TV. This meeting was taped and broadcast.

Copies of presentation slides are available from the LWVNC. Please contact sleepstudy@lwvnewcanaan.org

SLEEP STUDY GROUP HISTORY

In 2004, the LWV of New Canaan invited members of the LWV of Wilton and the town's school superintendent to a public forum in our town to describe their experience in delaying middle and high school start times.

Hearing about the positive experience that Wilton had, the study group began its own research into children's sleep needs and school start times. Group members have examined scientific studies and literature on the subject, medical journals, and other districts making changes in start times. In addition, the group has interviewed experts in the field of sleep medicine and sponsored public forums with expert speakers.

After presenting the idea of surveying the school community to the Board of Education in the fall of '05, the study group administered its survey about children's sleep habits and opinions regarding school start times to students in grades 4,6,8,10, and 12, New Canaan public school parents, and professional staff in all NCPS schools in February of '06. Results of these surveys were released at a public presentation on April 5th, and were reported in the local newspapers.

Throughout this entire process, the study group has maintained contact with Dr. Abbey, the New Canaan Superintendent of Schools, informing him of our progress and updating him about different steps we were taking. We are grateful for his cooperation as we've investigated this issue. (This does not signify any commitment on the part of the superintendent or the Board of Education to consider or act upon our recommendations.)

On June 1st, after obtaining a unanimous vote from its membership, the League of Women Voters of New Canaan issued to the public its position statement on sleep and adolescent health, along with a supporting fact sheet and overview.

Later in June, the League released its final report with all of its research findings, and it plans to make a formal presentation to the Board of Education in early fall '06.

CHRONOLOGY OF ACTIVITIES

4/19/04 Dr. Clune, superintendent of Wilton Public Schools and two members of the Wilton LWV discussed their research and the process to implement a 40 minute change in school start times for their High School and Middle School.

9/20/04 Organizational meeting of Sleep Study Group in New Canaan

9/27/04 Louise Herot and Lisa Bogan from the Wilton School Start Time Group come address New Canaan Sleep Study Group.

11/15/04 Dr. O'Malley and Dr. Fine, of the Norwalk Hospital Center for Sleep Disorders present their findings at an open meeting of the NCLWV.

1/10/05 Greg Macedo, Principal of Saxe Middle School and Jay Egan, Director of Athletics come as faculty members of NCPS invited to attend Sleep Study Group meeting to share concerns about adolescents, sleep needs, other health issues and complexities of scheduling.

1/21/05 Saul Rothenberg, PhD, sleep specialist from Greenwich Hospital addressed SST Group.

1/31/05 Dr. Elliott Landon, Superintendent of Westport Public Schools and Dr. Clive Belfied of Columbia University come to share their research on sleep needs of adolescents and school start times at an open meeting of the NCLWV.

2/28/05 Dr. Gary Richards, Superintendent of Wilton Public Schools and former Superintendent of New Canaan Public Schools address NC Sleep Study Group to discuss ramifications of the change in school start times after one year.

4/27/05 Lt. Jeffrey Dyche, USN, US Air Force Academy present findings at an open meeting of the LWV called "Changing Sleep Times in Air Force and Navy". He is joined by Drs. O'Malley and Fine from Norwalk Hospital.

7/18/05 Karen Conniff, Board of Education member of Old Lyme comes to address NC Sleep Study Group and present their health initiative which involved a pilot program delaying school start times. Mary Kolek of NCPS attends.

7/25/05 Roy Walder, Transportation Coordinator of the NCPS meets with members of the Sleep Study Group.

9/12/05 Sue Stone and Shelby Cromwell present survey concept to BOE.

9/27/05 Dr. Abbey, Superintendent of NCPS, and Shelby Cromwell and Sue Stone, Co Chairs of Sleep Study Group, meet with the council of PTC and PFA presidents to review drafts of surveys for parents, faculty and students in the New Canaan Public Schools.

2/06 All parents of students, professional staff of NCPS are invited to take an online survey. Students in grades 4,6,8,10 and 12 take paper survey in school.

4/5/06 Sleep Study Group holds public meeting to present findings of surveys.

5/31/06 Shelby Cromwell, Sue Stone, Jane Himmel present position statement to Dr. Abbey.

6/1/06 and public.	League releases position statement, fact sheet, overview document to BOE
6/06	League publishes Report on Adolescent Sleep Needs and School Start Times

*New Canaan survey questions and the survey findings presentation can be found in a hard copy of this report at the reference desk at the New Canaan Library and at the NCPS central office.