Executive Summary

This report is submitted pursuant to Chapter 620 of the Acts of 2014 (House Bill 883), which requires the Office of Public Health Services in the Department of Health and Mental Hygiene (DHMH or Department) to:

> "…review the science on the sleep needs of children and adolescents, including the effects of sleep deprivation on academic performance and benefits of sufficient sleep; review and study how other school systems have implemented alternative school day starting times and how various activities in those school systems were impacted and scheduled around the changes; and make recommendations regarding whether public schools should implement a starting time of no earlier than 8:00 a.m."

In response to this request, Part I, written by DHMH, provides a summary of the scientific literature on sleep physiology and sleep needs of youth, the effects of insufficient sleep on school performance and other parameters impacting academic and overall health and well-being, and the positive outcomes associated with sufficient sleep. Part II, written by the Maryland State Department of Education (MSDE), studies how other school systems have implemented alternative school day starting times. Additionally, a summary table of school districts that have implemented later start times is included. Finally, recommendations on whether earlier start times should be implemented will incorporate all findings.

Children and Adolescents: Maturation Means Less Sleep

While there is not perfect agreement as to what constitutes adequate sleep, there is general consensus among the health care community, including sleep science experts, that school-age children need at least eight hours (adolescents) to 10 hours (young children) of sleep each night. The literature on sleep and academic performance consistently shows that sleep (duration, efficiency, sleepiness) is an important predictor of attention and cognitive ability in children and adolescents. This topic has been studied in racially and economically diverse populations and among school systems in urban, suburban, and rural environments with similar results.

As young people pass from childhood into and through puberty, they take longer to fall asleep. Melatonin, the hormone that signals preparation for sleep, is secreted later in the evening, and shuts off later at night, another physiologic change which contributes to the basis for the later-to-bed, difficult-to-wake pattern of puberty. As children age through adolescence, they spend less time in the phase of sleep which is believed to be critical to brain refreshment and restoration. These normal changes of puberty, factors intrinsic to the child and his or her developmental stage, provide a biological foundation for insufficient sleep and daytime sleepiness in adolescents particularly when an early wake time is imposed.

Extrinsic factors, attributes, or practices in the life or environment of the child that contribute to decreased sleep have also been documented. Early school start time has been identified as one of the strongest predictors of shorter weeknight sleep duration in adolescents. Other factors negatively impacting sleep include social and extracurricular activities; computer, video game, and TV time; and caffeine use. Parental-set bedtime has been found to positively impact sleep duration.

Consequences of Insufficient Sleep

Insufficient sleep, however defined, has been associated with poorer academic performance across multiple age groups, and across several school subjects, including math, science, writing and social studies. With less sleep, children score lower on achievement tests and tests of eye-hand coordination, dexterity and non-verbal concept formation. Conversely, more sleep is associated with improvement in executive function and in measures of attention and impulsivity.

Poor health outcomes, including depression, anxiety, suicidal ideation, and overweight/obesity have been associated with insufficient sleep, particularly in adolescents. Some studies have found a link between reduced sleep and risk-taking behavior such as alcohol and drug use, tobacco use, sexual activity, and school truancy. Literature that supports an association between insufficient sleep and overweight/obesity is especially robust (although not completely unanimous). Although the literature consistently reports benefits from sufficient sleep, which may be achieved by implementing a later school start time, the studies have been conducted using a range of methodological approaches. The Department has highlighted some of the strengths and limitations of the literature in the body of the report.

Short sleep duration (less than six hours) is associated with subjective sleepiness while driving and significantly increased motor vehicle accidents, even controlling for a number of other clearly impactful variables, including alcohol and drug use, previous crash history and risky driving behaviors such as speeding.

Effects of Later School Start Times

Increased awareness of the sleep problems facing children and adolescents has driven national and local advocacy efforts to allow longer sleep times by delaying school start time. To date, over 100 schools and school districts in 43 states and the District of Columbia have implemented policies to begin school later, or have maintained a start time of 8:00 a.m. or later; the majority fall into the former category. The first U.S. schools to implement a later start time were in Edina, Minnesota, where change began nearly two decades ago in 1997. Of course, this list represents a small fraction of total U.S. schools, as evidenced by the fact that the mean national high school start time reported by the National Center for Education Statistics Schools and Staffing Survey has moved only five minutes, from 7:54 a.m. in the 2001-2002 academic year, to 7:59 a.m. in school year 2011-2012.

Additionally, a handful of schools and school districts in Canada, the United Kingdom, and South Korea have implemented later start times. Following later start times, schools in the U.S. and abroad have reported financial savings, improved academic achievement, improved mental and overall health, decreased motor vehicle accidents, and higher attendance and graduation rates. Increases in enrollment and attendance (including fewer tardy arrivals) have been noted in some schools where later start time has been implemented.

Students' subjective assessment of their own well-being is favorably affected: they report less daytime sleepiness and fatigue, greater motivation, and report better ability to stay awake while studying, taking tests or attending class. Objective parameters such as performance in a variety of school subjects, and in state and national achievement tests also show improvement. Notably, students were found to have lower

grades and more absences in their first period class than in other classes. It is also noted that poor performance in a first period math class may negatively impact performance in future math classes. Schools where start time is delayed may see a decrease in motor vehicle accident risk in surrounding neighborhoods, and in comparison to schools with earlier start times. A recent review of the effects of later start times noted a 65-70% reduction in motor vehicle crashes when school start times were delayed.