Goal: *Investigate how sleep deficit affects the structure and function of the human body*

SSR-A. Why Don't Teens Get Enough Sleep? (reading time estimate: 1:34)

Until recently, teens often got a bad rep for staying up late, oversleeping for school, and falling asleep in class. But recent studies show that adolescent sleep patterns actually differ from those of adults or kids.

Human brains secrete **melatonin** through the **pineal gland** in the brain. Research data is unclear about the function of melatonin, but it plays a strong role in regulating sleep-wake cycles and inflammation. Ingesting melatonin produces a 6% increase in sleep hours, at best.

Experts say that during the teen years, the body's **circadian rhythm** (an internal sunlight-darkness biological clock that most organisms experience) is temporarily reset, telling a person to fall asleep later and wake up later. This change might be due to the fact that the brain hormone **melatonin** is produced later at night for teens than it is for kids and adults. This can make it harder for teens to fall asleep early.

These changes in the body's circadian rhythm coincide with a busy time in life. For most teens, the pressure to do well in school is more intense than when they were kids, and it's harder to get by without studying hard. And teens also have other time demands — everything from sports and other extracurricular activities to working a part-time job to save money for college.

Early start times in some schools also might play a role in lost sleep. Teens who fall asleep after midnight may still have to get up early for school, meaning that they might squeeze in only 6 or 7 hours of sleep a night. A few hours of missed sleep a night may not seem like a big deal, but can create noticeable sleep deficits over time.


Answer Question 1 of 2 on your Do Now.

15A Why Is Sleep Important? (reading time estimate: 1:19)

Does an ongoing lack of sleep affect the **immune** system in helping fight infection? The answer is 'probably'. We know that when a person is sick, the immune system is helped by getting a good amount of sleep. The immune system wants and needs sleep.

Surprisingly, latest research also suggests a link between not getting enough sleep and becoming **overweight**. It seems that if someone is not getting enough sleep, the body uses glucose at a slower rate and this is likely to cause weight gain. Also, being sleep deprived makes you feel hungrier. So, one secret to losing weight seems to be getting enough sleep. Sleep helps keep us physically healthy, too, by slowing the body's systems to re-energize us for everyday activities.

A sleep deficit also affects everything from someone's ability to pay **attention** in class to their **mood**. Lack of sleep also is linked to feelings of sadness and **depression**. A National Sleep Foundation Sleep in America poll reported more than 25% of high school students fall asleep in class, and experts have tied lost sleep to poorer grades. Lack of sleep also damages teens' ability to do their best in athletics. The National Highway Safety Traffic Administration estimates that more than 100,000 accidents, 40,000 injuries, and 1,500 people are killed in the U.S. every year in **crashes** caused by drivers who are simply tired. More than half of teens surveyed reported that they have driven a car while drowsy over the past year and 15% said they drove drowsy at least once a week.


Answer Question 2 of 2 on your Do Now.

Goal: *Investigate how sleep deficit affects the structure and function of the human body*

SSR-A Physiology Do Now

Student _____ Class _____

Instructor Use: _____ / 16pts

When you were...	**What time did school start?**	**How many hours/night would you sleep on average?**
in 3rd grade (~age 8)		
in 7th grade (~age 12)		
in high school (now)		

Question 1 of 2: What is a possible reason for why teenage **circadian rhythms** (wakeful-drowsy cycles) get reset? Why does this happen temporarily at this stage of human development?

Question 2 of 2:

a) Estimate how many days out of the week that the amount of sleep you get **negatively** affects your appetite or mood.

b) What are a few reasons you think organisms need sleep? Why is "resting condition" so important for humans? What happens when you can't get back to resting condition?

Goal: *Investigate how sleep deficit affects the structure and function of the human body*

SSR-B. Am I Getting Enough Sleep? (reading time estimate: 0:11)

The **Stanford Sleepiness Scale** asks: Which of the following best describes how you are currently feeling?

- ❏ 1. Feeling active and vital; alert; wide awake
- ❏ 2. Functioning at a high level; but not at peak; able to concentrate
- ❏ 3. Relaxed; awake; not at full alertness; responsive
- ❏ 4. A little foggy, not at peak; let down
- ❏ 5. Fogginess, beginning to lose interest in remaining awake; slowed down
- ❏ 6. Sleepiness; prefer to be lying down; fighting sleep; woozy
- ❏ 7. Almost in reverie, sleep onset soon; lost struggle to remain awake

Even if you think you're getting enough sleep, you might not be. Here are some of the signs that you may need more sleep:

- difficulty waking up in the morning
- inability to concentrate
- more frequent hunger
- falling asleep during classes
- feelings of moodiness and even depression

Answer Question 1 of 2 on your Do Now.

SSR-B How Can I Get More Sleep? (reading time estimate: 2:33)

Some researchers, parents, and teachers have suggested that middle- and high-school classes begin later in the morning to accommodate teens' need for more sleep. Some schools have implemented later start times. You and your friends, parents, and teachers can lobby for later start times at your school, but in the meantime you'll have to make your own adjustments. Here are some things that may help you to sleep better:

1. **Set a regular bedtime.** Going to bed at the same time each night signals to your body that it's time to sleep. Waking up at the same time every day also can help establish sleep patterns. So try to stick as closely as you can to your sleep schedule, even on weekends. Try not to go to sleep more than an hour later or wake up more than 2 to 3 hours later than you do during the week.

2. **Exercise regularly.** Try not to exercise right before bed, though, as it can rev you up and make it harder to fall asleep. Finish exercising at least 3 hours before bedtime. Many sleep experts believe that exercising in late afternoon may actually help a person sleep.

3. **Avoid stimulants.** Don't drink beverages with caffeine, such as soda and coffee, after 4 p.m. Nicotine is also a stimulant, so quitting smoking may help you sleep better. And drinking alcohol in the evening can

make a person restless and interrupt sleep.

4. **Relax your mind.** Avoid violent, scary, or action movies or television shows right before bed — anything that might set your mind and heart racing. Reading books with involved or active plots may also keep you from falling or staying asleep.

5. **Unwind by keeping the lights low.** Light signals the brain that it's time to wake up. Staying away from bright lights (including computer screens!), as well as meditating or listening to soothing music, can help your body relax. Try to avoid TV, computers and other electronics, and using your phone (including texting) at least 1 hour before you go to bed.

6. **Don't nap too much.** Naps of more than 30 minutes during the day and naps too close to bedtime may keep you from falling asleep later.

7. **Avoid all-nighters.** Don't wait until the night before a big test to study. Cutting back on sleep the night before a test may mean you perform worse than you would if you'd studied less but got more sleep.

8. **Create the right sleeping environment.** Studies show that people sleep best in a dark room that is slightly on the cool side. Close your blinds or curtains (and make sure they're heavy enough to block out light) and turn down the thermostat (pile on extra blankets or wear PJs if you're cold). Lots of noise can be a sleep turnoff, too. Use a nature sounds or white-noise machine (or app!) if you need to block out a noisy environment.

9. **Wake up with bright light.** Bright light in the morning signals your body that it's time to get going. If it's dark in your room, it can help to turn on a light as soon as your alarm goes off.

Answer Question 2 of 2 on your <u>Do Now</u>.

Goal: *Investigate how sleep deficit affects the structure and function of the human body*

SSR-B Physiology Do Now

Student _____ Class _____

Instructor Use: _____ / 16pts

Question 1 of 2: Choose 2 symptoms from the list. What are possible causes for these symptoms that are NOT related to sleep? Explain your reasoning.

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Question 2 of 2: Do you use any of the strategies from the list to get more sleep? Answer these questions on the lines below.

a) Re-NUMBER the list in order of how easy it is to add to your routine, from most difficult to easiest.
b) What is the easiest thing you can try to do?
c) What is the most difficult thing you can try to do?
d) Why do you think these contribute to helping you get more sleep?

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Goal: *Investigate how sleep deficit affects the structure and function of the human body*

SSR-C Sleep mechanisms (reading time estimate: 1:30)

Two internal biological mechanisms–circadian rhythm and homeostasis–work together to regulate when you are awake and sleep.

(1/2) **Circadian rhythms** direct a wide variety of functions from daily fluctuations in wakefulness to body temperature, metabolism, and the release of hormones. They control the timing of sleep and cause you to be sleepy at night or to wake in the morning without an alarm. Your body's biological clock, which is based on a roughly 24-hour day, controls most circadian rhythms. Circadian rhythms synchronize with environmental cues (light, temperature) about the actual time of day, but they continue even in the absence of cues.

(2/2) **Sleep-wake homeostasis** keeps track of your need for sleep. The homeostatic sleep drive reminds the body to sleep after a certain time and regulates sleep intensity. This sleep drive gets stronger every hour you are awake and causes you to sleep longer and more deeply after a period of sleep deprivation.

Factors that influence your sleep-wake needs include medical conditions, medications, stress, sleep environment, and what you eat and drink. Perhaps the greatest influence is the exposure to light. Specialized cells in the retinas of your eyes process light and tell the brain whether it is day or night and can advance or delay our sleep-wake cycle. Exposure to light can make it difficult to fall asleep and return to sleep when awakened.

Night shift workers often have trouble falling asleep when they go to bed, and also have trouble staying awake at work because their natural circadian rhythm and sleep-wake cycle is disrupted. Dangerously, particularly sleep-deprived workers (like long-haul truck drivers, operating room surgeons, or train conductors) sometimes experience an involuntary, 30-second to 1 minute session of **microsleep**. Microsleep is a frequent cause of automobile collisions.

In the case of jet lag, circadian rhythms become out of sync with the time of day when people fly to a different time zone, creating a mismatch between their internal clock and the actual clock in your new location.

Answer Question 1 of 2 on your <u>Do Now</u>.

15C How Much Sleep Do You Need? (reading time estimate: 0:51)

Your need for sleep and your sleep patterns change as you age, but this varies significantly across individuals of the same age. There is no magic "number of sleep hours" that works for everybody of the same age. Babies initially sleep as much as 16 to 18 hours per day, which may boost growth and development (especially of the brain). School-age children and teens on average need about 9.5 hours of sleep per night. Most adults need 7-9 hours of sleep a night, but after age 60, nighttime sleep tends to be shorter, lighter, and interrupted by multiple awakenings. Elderly people are also more likely to take medications that interfere with sleep.

In general, people are getting less sleep than they need due to longer work hours and the availability of round-the-clock entertainment and other activities. Many people feel they can "catch up" on missed sleep during the weekend but, depending on how sleep-deprived they are, sleeping longer on the weekends may not be adequate.

Frequently, when busy schedules and demands crowd down-time, stress and emotions may pile up

throughout the day, only to crash when you've just gotten into bed. Strategies that help young people deal with emotions that stop and prevent sleep:

1. **Take time out but not in bed.** Sometimes our lives are so hectic that the only time we have left to try to work things through is when we go to bed. This starts a cycle of poor sleep that reduces how well we can cope with the emotions in the first place. Reflect on what's happening BUT don't do this right before you're about to sleep. Consciously make another time that is not near bedtime. Perhaps take a walk or listen to music and collect your thoughts. Breathe and reset.

2. **Look inside — why are you feeling this?** Emotions can be very confusing and it's a good idea to work out which types of emotions might be affecting you. *Joy, worry, guilt, envy, excitement, anger, resentment, helplessness, insignificance, sorrow...*People often feel more than one emotion at a time and it's worth trying to work out your own feelings. (Some people use a diary to help them think through their feelings or look at situations that have happened and their responses to them.) Whether a diary suits you or not, it's good to become a self-commentator—look inside your head and explore **why** you are feeling things. Don't get stuck in one groove. Look at things in a range of ways and avoid a simplistic explanation. Emotions are rarely simple.

3. **Challenge your thinking.** Sometimes your thoughts don't work in your favor and you need to turn them around.
    - **a.** If you are a worrier, be **realistic** about the consequences of future events. Are they likely to be major or minor? Think back to other times when you were worried – did things work out as badly as you had feared? Avoid seeing catastrophes around every corner. Learn from your past experiences and realise that being a pessimist (fearing the worst) can be stressful.
    - **b.** If you are angry about things you can't change then rehearse dialogues and **imagine** confronting the person or thing you are angry with. A few imaginary confrontations can help you get it out of your system but don't do this more than once or twice.
    - **c.** If you are the sort of person that says 'I can't do it' then think of all the things that you have been able to do successfully, even when you weren't sure. **Remember** things you have done that you have been proud of. If a group of people don't make you feel successful then think of situations with other people where you have felt more successful and tease out the reasons **why** you felt good in that situation.

4. **Don't bottle it up.** Guilt, sadness and depressed feelings are a natural reaction to some things that happen in life and the key is to work out what can be changed and what can't be. If you can get to some level of acceptance then it will reduce your stress.

Answer Question 2 of 2 on your Do Now.

Goal: *Investigate how sleep deficit affects the structure and function of the human body*

SSR-C Physiology Do Now **Student _____ Class _____**

Instructor Use: _____ / 16pts

Question 1 of 2: How might **microsleep** affect your **circadian rhythms**? Include the definition of both terms in your answer.

Question 2 of 2: According to the reading, why is it important to deal with our emotions and stress in a location separate from where we sleep?

In other words, why should you **never ponder where you slumber**?

Goal: *Investigate how sleep deficit affects the structure and function of the human body*

SSR-D The Role of Genes and Neurotransmitters (reading time estimate: 1:44)

(1/3) **Chemical signals to sleep**

Clusters of sleep-promoting neurons in many parts of the brain become more active as we get ready for bed. Nerve-signaling chemicals called neurotransmitters can "switch off" or dampen the activity of cells that signal arousal or relaxation. **GABA** is associated with sleep, muscle relaxation, and sedation. **Norepinephrine** and **orexin** (also called hypocretin) keep some parts of the brain active while we are awake. Other neurotransmitters that shape sleep and wakefulness include **acetylcholine**, **histamine**, **adrenaline**, **cortisol**, and **serotonin**.

(2/3) **Genes and sleep**

Scientists have identified several genes involved with sleep and sleep disorders, including genes that control the excitability of neurons, and "clock" genes such as *Per, tim,* and *Cry* that influence our circadian rhythms and the timing of sleep. Genome-wide association studies have identified sites on various chromosomes that increase our susceptibility to sleep disorders.

Also, different genes have been identified with such sleep disorders as familial advanced sleep-phase disorder, narcolepsy, and restless legs syndrome. Some of the genes expressed in the cerebral cortex and other brain areas change their level of expression between sleep and wake. Several genetic models–including the worm, fruit fly, and zebrafish–are helping scientists to identify molecular mechanisms and genetic variants involved in normal sleep and sleep disorders. Additional research will provide better understand of inherited sleep patterns and risks of circadian and sleep disorders.

(3/3) **Sleep studies**

Your health care provider may recommend a polysomnogram or other test to diagnose a sleep disorder. A polysomnogram typically involves spending the night at a sleep lab or sleep center. It records your breathing, oxygen levels, eye and limb movements, heart rate, and brain waves throughout the night. Your sleep is also video and audio recorded. The data can help a sleep specialist determine if you are reaching and proceeding properly through the various sleep stages. Results may be used to develop a treatment plan or determine if further tests are needed. Other tests include sleep apnea setups that patients can take home for a week's monitoring.

Answer Question 1 of 2 on your <u>Do Now</u>.

Goal: *Investigate how sleep deficit affects the structure and function of the human body*

SSR-D Anatomy of Sleep (reading time estimate: 2:15)

Several structures within the brain are involved with sleep.

(1/6) The **hypothalamus**, a peanut-sized structure deep inside the brain, contains groups of nerve cells that act as control centers affecting sleep and arousal. Within the hypothalamus is the suprachiasmatic nucleus (SCN) – clusters of thousands of cells that receive information about light exposure directly from the eyes and control your behavioral rhythm. Some people with damage to the SCN sleep erratically throughout the day because they are not able to match their circadian rhythms with the light-dark cycle. Most blind people maintain some ability to sense light and are able to modify their sleep/wake cycle.

(2/6) The **brain stem**, at the base of the brain, communicates with the hypothalamus to control the transitions between wake and sleep. (The brain stem includes structures called the pons, medulla, and midbrain.) Sleep-promoting cells within the hypothalamus and the brain stem produce a brain chemical called GABA, which acts to reduce the activity of arousal centers in the hypothalamus and the brain stem. The brain stem (especially the pons and medulla) also plays a special role in REM sleep; it sends signals to relax muscles essential for body posture and limb movements, so that we don't act out our dreams.

(3/6) The **thalamus** acts as a relay for information from the senses to the cerebral cortex (the covering of the brain that interprets and processes information from short- to long-term memory). During most stages of sleep, the thalamus becomes quiet, letting you tune out the external world. But during REM sleep, the thalamus is active, sending the cortex images, sounds, and other sensations that fill our dreams.

(4/6) The **pineal gland**, located within the brain's two hemispheres, receives signals from the SCN and increases production of the hormone melatonin, which helps put you to sleep once the lights go down. People who have lost their sight and cannot coordinate their natural wake-sleep cycle using natural light can stabilize their sleep patterns by taking small amounts of melatonin at the same time each day. Scientists believe that peaks and valleys of melatonin over time are important for matching the body's circadian rhythm to the external cycle of light and darkness.

(5/6) The **basal forebrain**, near the front and bottom of the brain, also promotes sleep and wakefulness, while part of the midbrain acts as an arousal system. Release of adenosine (a chemical by-product of cellular energy consumption) from cells in the basal forebrain and probably other regions supports your sleep drive. Caffeine counteracts sleepiness by blocking the actions of adenosine.

(6/6) The **amygdala**, an almond-shaped structure involved in processing emotions, becomes increasingly active during REM sleep.


Answer Question 2 of 2 on your <u>Do Now</u>.

Goal: *Investigate how sleep deficit affects the structure and function of the human body*

SSR-D Physiology Do Now **Student _____ Class _____**

Instructor Use: _____ / 8pts

Question 1 of 2: How do GABA, norepinephrine, and orexin affect sleep? According to the reading, what are several kinds of data you could collect to find out if you had a sleep disorder?

Question 2 of 2: Which of the six structures in the reading do you think is most responsible for

a) ... getting you to sleep?

Why? Explain your reasoning.

b) … keeping you safe and calm while you sleep?

Why? Explain your reasoning.

c) … (hopefully) entertaining you in your sleep?

Why? Explain your reasoning.

Do Nows - Silent Sustained Reading ***"The Science of Adolescent Sleep"***

Goal: *Investigate how sleep deficit affects the structure and function of the human body*

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