Fatigue Awareness and Countermeasures (Technical Operations): Sleep Basics

Welcome to the Fatigue Awareness and Countermeasures Course. This document has been designed to be used in conjunction with the online course for learners that do not have audio or need additional resources in completing the course.

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Section 1 – Overview

1 Sleep Basics
This lesson describes basic information about sleep. Now that you've learned the basics about fatigue, you will learn about sleep basics such as why we need sleep, the sleep process, your body's natural body clock, sleep disorders, sleep quantity and quality and sleep debt.

Please note that this lesson contains an audio option.

If you need access to the narration text, which also includes screen images, click the Text Version button.

When you're ready to get started, click Next.

2 Lesson 2 Objectives

This lesson describes the basics about sleep. This section will introduce you to some very basic information about sleep.

Read through the lesson objectives listed here. Then click Next to continue.
Section 2 – Sleep Basics

3 Sleep Basics Overview

Just like food, water, or air, sleep is a basic need for survival. Yet, as important as sleep is to well-being, The National Institute of Health reports that an estimated 50 to 70 million Americans are affected by sleep problems, either chronic sleep disorders or intermittent problems sleeping.

A survey of workers involved in workplace accidents revealed that 55% of those polled reported having sleep difficulties.

Those individuals accounted for 75% of the workplace accidents that required medical treatment.

In other words, individuals with sleep difficulties are more likely to be involved in severe workplace accidents. Click Next to continue.
Why Do We Need Sleep?

Sleep is a basic physiological need. There is often a mindset of being “tough” about going without sleep, but would you ever try to go without water, or air? Probably not, and with good reason. Sleep is necessary for the mind and body to restore itself at the end of the day and to prepare for the next day. Obtaining 8 hours of quality sleep in each 24 hour period will minimize fatigue and is considered the only effective long-term countermeasure for fatigue. Without sleep, we literally cannot survive. Click Next to continue.
The process of sleep is actually made up of cycles each lasting approximately 90 to 120 minutes and is repeated throughout the entire sleep period.

Each cycle consists of two different phases: non-rapid eye movement sleep or NREM, and rapid eye movement sleep or REM. Both phases are necessary for restoration although they differ in some important ways.

The last cycle of the sleep period is often incomplete due to waking up by alarm clock or other outside stimuli. Waking up during an incomplete cycle can result in a groggy feeling when you first wake up. This groggy feeling is known as sleep inertia and typically lasts for 15-20 minutes after waking.

Click on each flashcard to learn more about the sleep phases. When you're finished, click Next to continue.
6 Sleep Inertia

Sleep inertia is a physiological state characterized by grogginess in the first 15-20 minutes after a sleep period. It is associated with decrements in cognitive performance, thus having implications for safety critical tasks in aviation environments. The intensity of the effects of sleep inertia varies with the depth of the prior sleep period and time of day, and is more likely to occur when awakening from NREM3 or NREM4 deep sleep.

Since sleep inertia is a physiological function, it cannot be eliminated but you can take steps to minimize its effects. Immediately upon awakening, get out of bed and engage in alerting activities such as washing the face, exposure to lights or noise, deep breathing, physical activity and social interaction. Don’t stay in bed because you are more likely to fall back to sleep. It is also important to obtain your daily sleep need (~7-9 hours) in a single consolidated period. This will help to ensure that you have gone through a full night of sleep cycles and you will be less likely to awaken from NREM 3 or NREM4. Avoid long periods of wakefulness before shortened sleep periods because slow wave sleep will more likely occur and exacerbate the sleep inertia experienced upon awakening. When napping, limit yourself to 20 minutes but if the nap is longer, allow yourself about 30 minutes to ‘wake-up.’ Drinking a caffeinated beverage before a nap can also help to minimize the effects of sleep inertia because it takes 30 minutes or so for caffeine’s mechanism of action to take place on the central nervous system. This would coincide with the time you are awakening. Click Next to continue.
A sleep cycle consists of two distinct phases, NREM and REM. You need both types of sleep to restore a sleep deficit. It’s important to realize that all sleep is restorative, and that the sleep process is adaptive. Your body is able to determine how to restructure the timing of NREM and REM in your sleep cycles to help you efficiently recover from your sleep debt so you don’t need to sleep an hour for every hour lost. Can you imagine having to sleep an extra 24 hours every weekend to make-up for the equivalent of a 1 day sleep debt you accumulated during the work week? It would be nearly impossible! That is why the body helps us to more efficiently recover from sleep loss.

In general, people spend more time in stages 3 and 4 sleep at the beginning of the night and an increasing amount of time in REM sleep as the sleep period progresses. This doesn’t hold as true for daytime sleep, which may be more variable. The process of sleep is why it’s important to maintain sleep periods of many hours in a continuous block, and why you can’t get by on naps alone. Click Next to continue.
The first step to mitigating fatigue is to get adequate, high-quality sleep. When you get adequate sleep, you should be able to sit quietly during the day and remain alert even if you're feeling bored. If you feel the urge to doze every time that you sit down, you are likely fatigued or might have an underlying sleep disorder. This does not necessarily apply to the nighttime or mid-afternoon hours due to the influence of the circadian clock.

The elements of good sleep are displayed. Drag each element to learn more about beating fatigue, then click Next to continue.
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9 Sleepiness Scale

Now let's see how sleepy you are. The Epworth Sleepiness Scale is a tool commonly used by fatigue experts to determine how much your sleep is affecting your daily activities.

In the following situations, how likely are you to doze off or fall asleep, in contrast to just feeling tired? This refers to your usual way of life in recent times. Even if you haven’t done some of these things recently, try to work out how they would have affected you.

Use the scale shown here to choose the most appropriate number for each situation, and answer as honestly as you can. When you are ready to start, click the Start Activity button.
If you don’t get enough sleep or if your sleep is of poor quality, you will accumulate a ‘sleep debt.’

Sleep debt is the difference between the amount of sleep a person should get, and the amount of sleep that they do get. This debt must be repaid in order for you to perform optimally.

Unfortunately, the sleepiness and fatigue associated with sleep debt is also cumulative. This means that losing even an hour of sleep each night over the course of a week can accumulate into a substantial debt that negatively affects performance. For example, individuals that get 6 hours of sleep per night for 11 nights, perform like someone who has not slept at all for 24 hours.

Similarly, individuals that get 4 hours of sleep per night for 6 nights, also perform like someone who has not slept at all for 24 hours. Click Next to calculate your sleep debt.
Now let’s calculate your sleep debt. How much sleep do you owe the "sleep bank?" The Sleep Debt Calculator that you will be using is adapted from one that was developed by Alertness Solutions.

Follow the steps to compute your personal sleep debt in a 4-step calculation by the following method. Personal results are not tracked or recorded. Use the calculator in this module or follow the same steps and conduct your own calculations offline. When you are ready to start, click the Start Activity button.

Luckily, sleep debt does not have to be re-paid hour for hour. When operating with a sleep debt, the body “rebounds” and increases the amount of deep sleep. This is known as recovery sleep and your body helps you to recover from the sleep that you lost by resetting your sleep debt to zero.

To help restore alertness, two nights of uninterrupted sleep can go a long way. Most people will sleep for anywhere between eight to twelve hours when recovering from a sleep debt. The important thing is to allow your body to determine when it has received enough sleep and to wake up naturally. If you still feel fatigued after two nights of uninterrupted sleep, then you will need to get additional sleep to fully restore alertness. Click Next to continue.
13 The Circadian Clock

Sleep isn’t the only factor influencing fatigue; the body’s internal clock also plays a role in determining alertness. Known as the circadian clock, the body responds to certain environmental cues and coordinates physiological functions to a 24 hour cycle. In general, when exposed to a regular sunrise and sunset, your body is programmed to be awake when it’s light and go to sleep when it’s dark.

The circadian clock responds primarily to variations in light and darkness which makes shift work particularly difficult for many people. Shift work/rest schedules and social interactions aren’t in themselves sufficient to effectively adapt the circadian clock. The influence of the circadian clock is one of the key factors that makes non-traditional work schedules interfere with natural sleep times making them so challenging. Click Next to continue.

14 Circadian Rhythms of Body Functions

The circadian clock is so important, that in addition to sleeping patterns, it controls many body functions. It’s also responsible for fluctuations in digestion, hormone production, body temperature, and the cardiovascular system. Click on each item to learn more about how the circadian rhythm affects each body function. When you are finished, click Next to continue.
The chart shows the highs and lows of the circadian rhythm of alertness. Labels for the corresponding levels of alertness that people experience throughout the day are shown on the left. The circadian rhythm peaks in the midmorning and then again around the early evening. Notice a clear dip around 3:00pm followed by an increase in alertness that peaks between approximately 6:00pm and 9:00pm, then another decline that reaches its low between approximately 3:00am and 5:00am. The early morning hours are when you're more likely to be a danger to yourself and others. However, this is based on a person who is going to sleep around 11:00pm and waking around 7:00am. There are individual differences in circadian rhythms and the peaks and dips in alertness may vary among individuals. Click Next to continue.
Fatigue is the result of the interaction between sleep history and the circadian clock. To understand sleep history, think about how well you slept during your last sleep period, how long you slept, and how long it’s been since you slept. When the circadian clock is out of time with the work schedule, signs and symptoms of fatigue may increase, making performance errors more likely as the body is naturally preparing for sleep. Click Next to see how the circadian clock and sleep history interact to make accidents and incidents more likely due to degraded cognitive performance.

This is William. Watch how the combination of extended hours of wakefulness and a circadian clock misalignment can impact cognitive performance in a manner similar to intoxication. Drag each drink to William’s mouth to see the impact.
As the time since your last sleep period increases, your level of performance is likely to decrease. We saw this with the research that compared fatigued performance with intoxicated performance - the longer people stayed up, the worse their cognitive performance became. Now give William the next drink.

After 24 hours awake, performance resembles that of someone who is legally drunk with a blood alcohol content of .10. This research was done using a regular day shift schedule where people wake up in the morning and stay awake throughout the evening and into the nighttime hours. In this instance, performance was affected not only by hours of wakefulness, but also the body’s natural cycle of wakefulness which is cued by the circadian clock. Now give William the next drink.
The combination of continuous wakefulness, and a misalignment with the circadian clock can interact to produce greater performance declines than would be found with either factor individually. For example, continuous wakefulness and work at 2 am would likely result in more errors than the same continuous wakefulness with work at 9 am. In this case, the circadian clock would make the errors more likely at 2 am when the body is naturally prepared for sleep. Click Next to continue.

18 Sleep History

This interaction between the circadian clock and sleep history is what allows you to get your “second wind” after staying up all night. In the morning hours, the circadian clock automatically signals for increased alertness and tells your body to wake up. You are also likely to experience a period of increased alertness in the late afternoon or early evening hours. This produces the “second wind,” but because you haven’t had any or much sleep you’re likely to still feel a little tired because you’ve been awake so long. Think of your “second wind” as your body trying to trick you into thinking that you are not fatigued when you really are. You may feel like you can perform effectively, but you will not be performing at 100%. Click Next to continue.
Section 6 – Sleep Disorders

19 Sleep Disorders Overview

Any time we talk about sleep loss or circadian rhythm disruption, we have to talk about the role of sleep disorders.

Sleep disorders involve any difficulties related to sleeping; including difficulty falling or staying asleep; falling asleep at inappropriate times; excessive total sleep time; or abnormal behaviors associated with sleep.

The National Institute of Health reports that an estimated 50 to 70 million Americans are affected by sleep problems – either chronic sleep disorders or intermittent problems sleeping.

Sleep disorders are considered the number one cause of workplace accidents, and individuals with sleep difficulties are more likely to be involved in workplace accidents.

In this section you will learn about symptoms that may indicate that you have a sleep disorder, as well as information about the most common sleep disorders.

Click Next to continue.
Sleep disorders can lead to a sleep deficit by preventing you from sleeping or from sleeping soundly. They can be particularly insidious because you may not even be aware that you have a problem, since often those with sleep disorders simply become accustomed to feeling fatigued.

There are a number of symptoms that may indicate a sleep disorder. Read through some of the common symptoms listed here. When you are finished, click Next to continue.

### 21 Common Sleep Disorders

Some of the most common sleep disorders are listed here. Click each disorder to learn more. When you are finished, click Next to continue.
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22 Complications from Sleep Disorders

Sleep disorders may lead to serious problems such as high blood pressure, morning headaches, and constantly fighting sleep. Sometimes people will become accustomed to feeling fatigued and when they finally seek treatment, the response is one of surprise because they feel so much better when they are finally able to get quality rest.

Fortunately, many sleep disorders can be effectively treated and managed. If you or a family member suspects that you suffer from a sleep disorder, please talk to your doctor. They can help you to determine if this is the case and what can be done to relieve your symptoms. Click Next to continue.

Section 7 – Review
Section 8 – Summary

28 Summary of Sleep Basics Section

Well done! You have completed the Sleep Basics lesson.

Here is a summary of what you have learned.

Since the questions in the Course Exam are based on the content presented in all three lessons of this course, be sure that you have completed and have a thorough understanding of each section before moving forward. To review any section of this lesson, click on Lesson Menu, then select the topic you want to review.

To return to the Main Menu, where you can click to navigate to other lessons, click Next.

Remember, you must complete all three lessons prior to taking the course exam.