Federal Aviation Administration

Initial En Route Qualification Training

Instructor
Lesson 30
Fatigue Awareness

Course 50148001

LESSON PLAN DATA SHEET

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HANDOUTS:	NONE
EXERCISES:	1
END-OF-LESSON TEST:	NONE
PERFORMANCE TEST:	NONE
MATERIALS:	NONE
OTHER PERTINENT INFORMATION:	NONE

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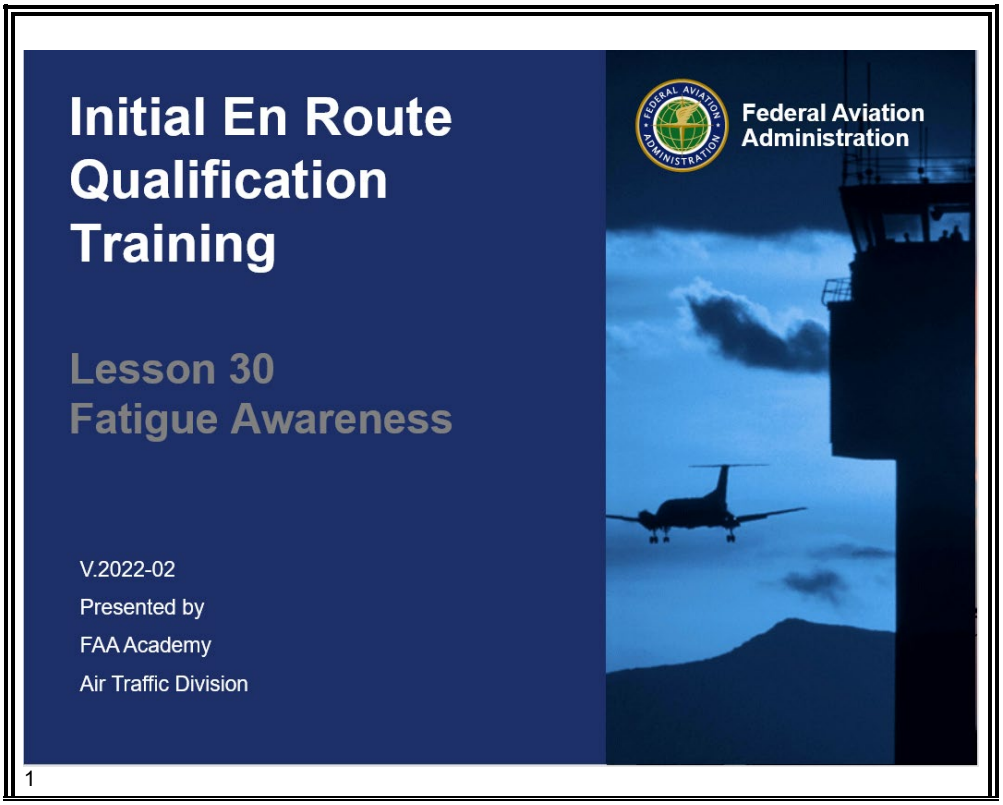
INTRODUCTION

Gain Attention



INTRODUCTION *(Continued)*

Gain Attention (Cont'd)

- The unique characteristics of the air traffic controller environment promote susceptibility to fatigue.
  - Facilities must staff personnel 24 hours a day, seven days a week.
  - For shift workers, sleep debt and fatigue can pose potential challenges and become difficult to manage.
- As you start your training in the field of air traffic control, it is important to be able to identify the common factors that can lead to fatigue.
- It is important to your health, the safety of others, and to your family life that you learn how to recognize the symptoms of fatigue and what measures you can take to avoid it.

Fatigue Awareness and Countermeasures Lesson Goals

Fatigue Awareness Lesson Goals

This lesson will:

- **Raise your awareness about fatigue**
  - Fatigue Basics
  - Sleep Basics
- **Provide countermeasures to help you manage fatigue on and off the job**

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INTRODUCTION *(Continued)*

Overview

⊙ This lesson will:

- Raise your awareness about:
  - Fatigue Basics
  - Sleep Basics
- Provide countermeasures to help you manage fatigue on and off the job

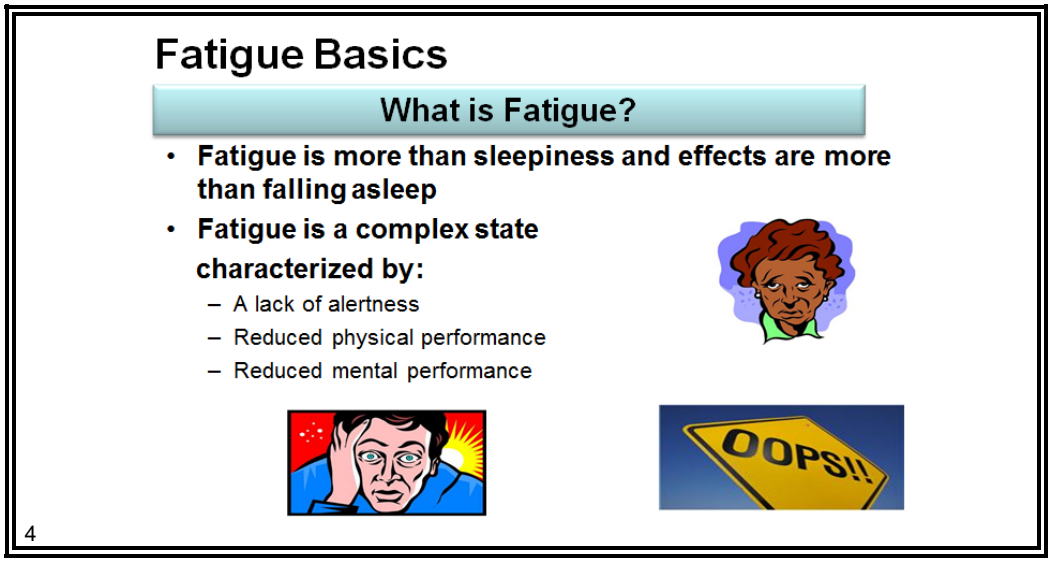
Lesson Objectives

⊙ At the end of this lesson, you will:

- Understand the importance of personal fatigue management
- Identify ways to increase alertness on night shifts
- Identify means to avoid sleep loss
- Understand how substances can affect alertness

FATIGUE BASICS

Fatigue Basics



What Is Fatigue?

- ⊙ Fatigue is more than sleepiness and effects are more than falling asleep.
- ⊙ Fatigue is a complex state characterized by:
  - A lack of alertness
  - Reduced physical performance
  - Reduced mental performance
- ⊙ An example of one's awareness of fatigue is similar to becoming aware of being thirsty. Your body is in need of fluids long before you become aware of feeling thirsty.

☞ ***NOTE:*** *Nobody wants an "oops" moment; reducing fatigue reduces the chances.*

SIGNS AND SYMPTOMS OF FATIGUE

☞ ***NOTE:*** *PowerPoint presentation. There are 6 transitions in this presentation. The Signs and Symptoms title and the three check marks are displayed first; click, the Physical column is displayed, click again, the Physical column fades, click again and the Mental column is displayed, click again, the Mental column fades, click again, the Emotional column is displayed, click again, the next slide is displayed.*

Signs and Symptoms

Signs and Symptoms

Physical	Mental	Emotional
• Yawning • Eye-rubbing • Heavy eyelids • Nodding off • Headaches, nausea, upset stomach • Slowed reaction time • Lack of energy, weakness, light headedness • Microsleeps	• Difficult to concentrate • Lapses in attention • Failure to communicate important information • Failure to anticipate events • Mistakes on well-practiced tasks • Forgetfulness • Difficulty thinking clearly • Poor decision making	• Low motivation to perform well • More quiet or withdrawn than normal • Low morale • Heightened emotional sensitivity • Short tempered, irritable or grumpy

☞ ***NOTE:*** *The instructor can read the lists or the instructor can ask the students to read the lists.*

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Physical, Mental, and Emotional Symptoms

⊙ There are many signs and symptoms that may indicate fatigue, they generally fall into one of the following three categories:

- physical,
- mental, or
- emotional

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SIGNS AND SYMPTOMS OF FATIGUE *(Continued)*

Physical, Mental, and Emotional Symptoms (Cont'd)

⊙ Physical Signs and Symptoms

☞***NOTE:*** *Read the list.*

- Yawning
- Eye-rubbing
- Heavy eyelids
- Nodding off and micro sleeps
  - brief nodding off even in seconds,
  - loss of awareness,
  - slowly drifting off,
  - jerk awakening,
  - can be especially dangerous when performing safety critical tasks or when operating machinery
- Headaches, nausea, upset stomach
- Slowed reaction time
- Lack of energy, weakness, light headedness

☞***NOTE:*** *Read the list.*

⊙ Mental Signs and Symptoms

- Difficult to concentrate
- Lapses in attention
- Failure to communicate important information
- Failure to anticipate events
- Mistakes on well-practiced tasks
- Forgetfulness
- Difficulty thinking clearly
- Poor decision-making

⊙ You will see more about the consequences of these signs and symptoms throughout the lesson.

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SIGNS AND SYMPTOMS OF FATIGUE *(Continued)*

Physical, Mental, and Emotional Symptoms (Cont'd)

☞ ***NOTE:*** *Read the list.*

⊙ Emotional Signs and Symptoms

- Low motivation to perform well
  - You just do not care
- More quiet or withdrawn than normal
- Low morale
- Heightened emotional sensitivity
- Short tempered, irritable, grumpy or snippy
- Are likely to be problematic in social situations
- Influences how a person approaches or deals with coworkers, family, and friends

⊙ This not an exhaustive list.

⊙ These symptoms do not necessarily indicate fatigue; rather a collection of symptoms often signifies that a person is experiencing at least some level of fatigue.

FATIGUE IN AN OPERATIONAL ENVIRONMENT

☞ ***NOTE:*** *PowerPoint presentation: There are 10 transitions in this presentation. The titled information is displayed first; the remaining 9 transitions, click, each bullet under both columns will display.*

Fatigue in an Operational Environment

Fatigue in Operational Environment

Mental Signs and Symptoms

Potential Manifestation With Controllers	Potential Manifestation With Pilots
• Failure to catch an incorrect or incomplete readback • Transposing a response to another aircraft's clearance (similar sounding call signs) • Forgetting an assigned altitude Issuing unclear control instructions (taxi/altitude/heading)	• Incorrect or incomplete readback • Response to another aircraft's clearance (similar sounding call signs) • Failure or slowed response to control instructions • Delayed frequency change • Multiple requests to repeat clearances • Clearance confusion (taxi/altitude/heading)

☞ ***NOTE:*** *The instructor can read the lists or the instructor can ask the students to read the lists.*

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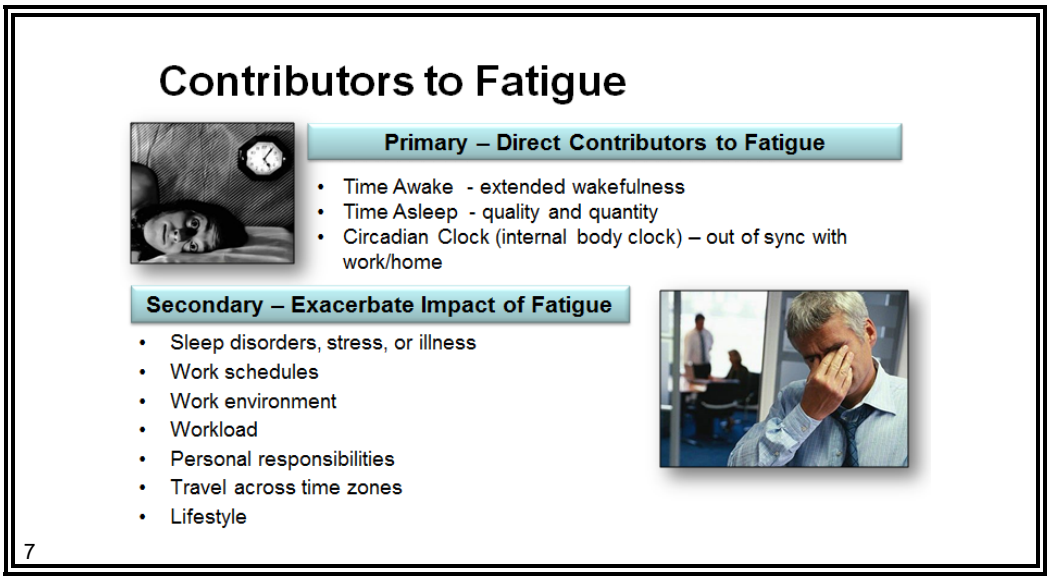
Overview

- ⊙ Fatigue signs and symptoms are the same regardless of occupation, but may manifest themselves in a similar manner
- ⊙ Controllers and pilots are interdependent
  - Controllers should be aware that pilots may be fatigued as well
  - Recognize the manifestation of fatigue may appear in both occupations
  - When either or both are fatigued, the result could be loss of separation or loss of life.

CONTRIBUTORS TO FATIGUE

☞ ***NOTE:*** *PowerPoint presentation: There are 4 transitions in this presentation. The title and 2 graphics are displayed first; click, the "Primary" title bar displays; click again the 3 bulleted text display; click again the "Secondary" title bar displays; click again the 7 bulleted texts display.*

Contributors to Fatigue



Primary Fatigue Factors

⊙ Primary – Direct Contributors to Fatigue:

- Time awake
  - Extended Wakefulness
    - → Sleep history and the length of continuous wakefulness or how long you have been awake
    - → Shift lag feels very similar to jet lag
- Time asleep
  - Quality and quantity of sleep
  - Restricted or disrupted sleep and sleep loss

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CONTRIBUTORS TO FATIGUE *(Continued)*

Primary Fatigue Factors (Cont'd)

- Circadian clock (internal body clock)
  - Out of sync with work and/or home
  - Your life or work schedule is out of sync with when your body has programmed you to be awake and when it has programmed you to be asleep.

Secondary Fatigue Factors

⊙ Secondary Fatigue Factors

- Sleep disorders, stress or illness
- Work schedules
- Work environment
- Workload – heavy or light
- Personal responsibilities
- Travel across time zones
- Lifestyle
  - Examples – your children's sporting events, family commitments

REVIEW

Review

QUESTION: How may aviation safety be impacted when both the controller and pilot are fatigued?

POSSIBLE ANSWERS:

Controllers:

Failure to catch an incorrect or incomplete read back

Transposing a response to another aircraft's clearance (similar sounding call signs)

Forgetting an assigned altitude; issuing unclear control instructions (taxi/altitude/heading)

Pilots: *Incorrect or incomplete read back*

Response to another aircraft's clearance (similar sounding call signs)

Failure or slowed response to control instructions

Delayed frequency change

Multiple requests to repeat clearances; clearance confusion (taxi/altitude/heading)

☞ ***NOTE:*** *Discuss with the student's their responses.*

INSTRUCTOR-LED DISCUSSION

Discussion

QUESTION: What currently contributes to your fatigue?

☞ ***NOTE:*** *Discuss with the student's their responses.*

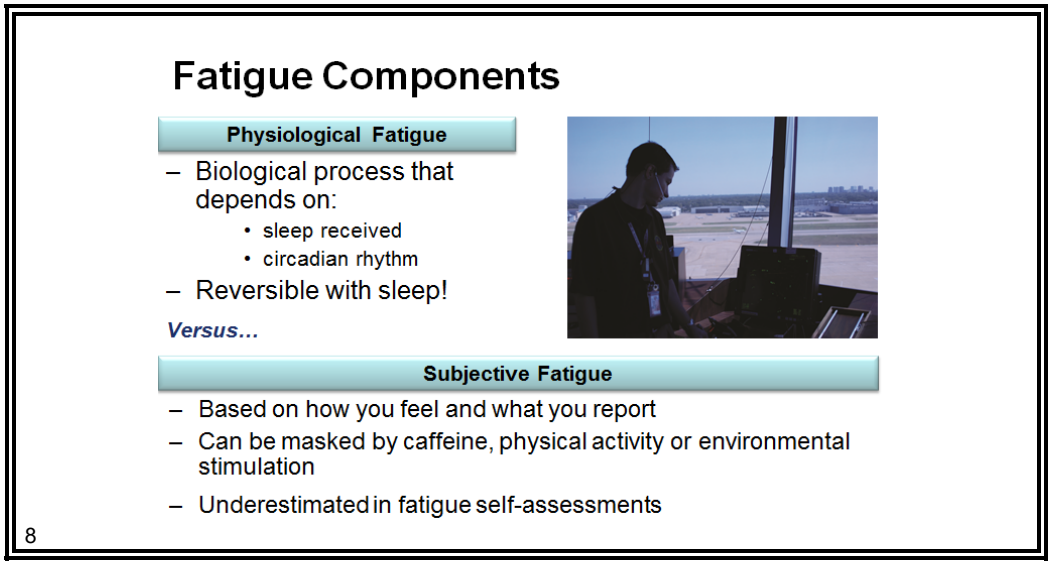
QUESTION: What factors do you think may contribute to your fatigue once you begin shiftwork?

☞ ***NOTE:*** *Discuss with the student's their responses.*

FATIGUE COMPONENTS

☞ ***NOTE:*** *PowerPoint presentation: The title and the graphic are displayed first; click again the "Physiological Fatigue" title bar displays; click again, "Biological process….. displays, click again both bulleted text displays, click again, "Reversible…. and Versus…" displays, click again, the "Subjective Fatigue" title bar displays, click again the remaining text is displayed.*

Fatigue Components



Overview

⊙ There are two distinct components or ways to talk about fatigue, either:

- physiological or
- subjective

FATIGUE COMPONENTS *(Continued)*

Review

QUESTION: Can a person be fatigued if they do not feel fatigued?

ANSWER: *Yes. If you think you are fatigued, you are. If you don't think you are fatigued, you might be.*

☞***NOTE:*** *Discuss with the student's their responses.*

Physiological Fatigue

- Physiological fatigue is a biological process that depends on the amount of sleep received and the circadian rhythm (the "rhythm" of your internal body clock.
- It is the result of an interaction between sleep loss and the circadian rhythm.
- Together, these factors contribute to the body's response to the physiological need for sleep.
- The only way to reverse physiological fatigue (sleep deprivation) is through sleep.

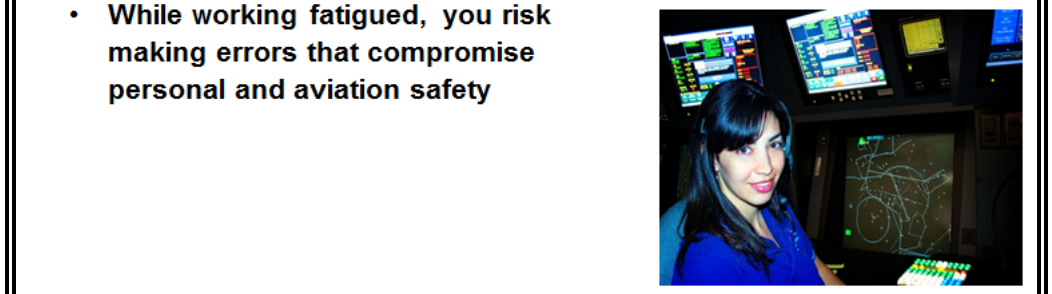
Subjective Fatigue

- Subjective fatigue is based on how you feel and how fatigued you report feeling.
  - It is still physiological fatigue, but the feeling of fatigue is often masked by:
    - motivation
    - caffeine
    - physical activity
    - environmental stimulation
  - These factors influence the level of fatigue that is reported, but not the underlying physiological fatigue that is present.
- Fatigue is very difficult for people to reliably estimate, especially when they are fatigued.
  - Tend to underreport fatigue
- Often subjective measures of fatigue are much more optimistic than physiological measures.
  - On average, you are probably more fatigued than you realize and therefore, a bigger safety threat than you realize.

FATIGUE SAFETY HAZARDS

☞ ***NOTE:*** *PowerPoint presentation: The title and the graphic are displayed first; click again "Fatigue can have…." displays; click again, "deterioration…."text displays, click "increased…." text displays, click the "While working fatigued…… text displays.*

Fatigue Safety Hazards



Overview

- ⊙ Fatigue can have serious consequences:
  - deterioration of on-the-job performance
  - increased risk of accidents and incidents
- ⊙ Working while fatigued, you risk making errors that compromise personal and aviation safety.
- ⊙ Think about the ripple effect on safety
- ⊙ A simple error may impact aviation safety including decisions other controllers you may work with are making.

INSTRUCTOR-LED DISCUSSION

Discussion

QUESTION: What safety impact would deterioration of on-the-job performance and increased risk of accidents/incidents cause?

☞ ***NOTE:*** *Discuss with the student's their responses.*

QUESTION: What are some errors that could compromise safety?

☞***POSSIBLE ANSWERS:*** *Miss an incorrect read back*
Assign a wrong altitude
Miscommunicate traffic management initiatives
Special Use Airspace status
Forget there is an aircraft in position

☞ ***NOTE:*** *Discuss with the student's their responses.*

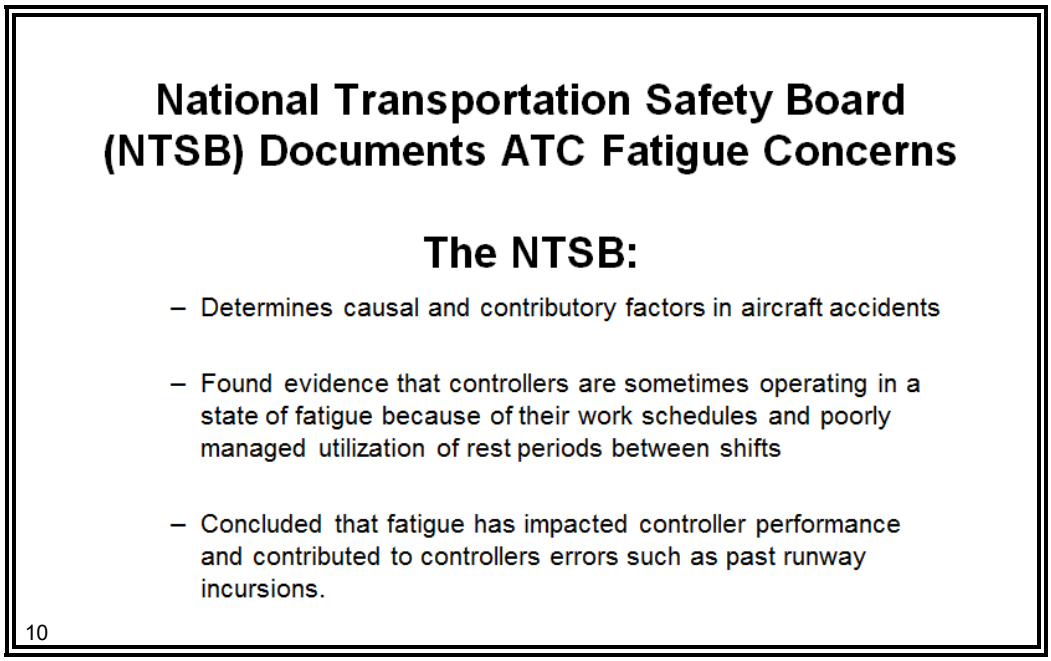
QUESTION: What safety impact might result from the errors we just discussed?

☞ ***NOTE:*** *Discuss with the student's their responses.*

NTSB ATC FATIGUE CONCERNS

☞ ***NOTE:*** *PowerPoint presentation: This presentation has 4 transitions. The title is displayed first; click, the first bullet displays, click again the second bullet displays, click again the last bullet displays.*

NTSB Documents ATC Fatigue Concerns



NTSB

- The National Transportation Safety Board (NTSB) is responsible for determining causal and contributory factors in aircraft accidents.
- If the NTSB is concerned about air traffic controller fatigue, then controllers need to be concerned as well.
- The NTSB:
  - Found evidence that controllers are sometimes operating in a state of fatigue because of their work schedules and poorly managed utilization of rest periods between shifts.
  - Concluded that fatigue has impacted controller performance and contributed to controllers errors such as runway incursions.

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NTSB ATC FATIGUE CONCERNS *(Continued)*

NTSB (Cont'd)

- On April 10, 2007, the NTSB issued Safety Recommendations to NATCA and the FAA, requiring that they work together to address controller fatigue.
  - The runway incursions referred to in the NTSB's Safety Recommendation Letter are examples of what any controller could easily do or fail to do when working fatigued.
  - Fatigue is serious, be it can be managed.
- Controller fatigue-related error was not cited for their specific accident investigations, but they found other instances where compelling evidence showed controllers worked fatigued
- Evidence developed from the Board's investigations of the following four runway incursions, highlight the impact fatigue can have on controller performance.
- The NTSB looks at five variables when determining whether fatigue is an issue in the investigation:
  1. Time of day
  2. Acute sleep loss in comparison to normal sleep pattern
  3. Presence of several days of accumulative sleep debt
  4. Time since awake
  5. Workload

☞ ***NOTE:*** *The following four scenarios are terminal examples taken from the NTSB letter. En route students should still be able to see how fatigue could impact the work that they do in the en route environment.*

NTSB ATC FATIGUE CONCERNS *(Continued)*

☞ ***NOTE:*** *Select two or more of the following scenarios to complete this section of the training. The instructor can read the scenarios or the instructor can ask the students to read the scenarios.*

March 2006 - Chicago, Illinois

March 2006 – Chicago, Illinois

A Chicago O'Hare controller issued conflicting clearances to two passenger planes. The controller cleared an Airbus 320 to cross an intersecting runway, then less than 15 seconds later, cleared a Boeing 737 to take off on that runway. The B737 pilots saw the A320, rejected the takeoff, and stopped before reaching the taxiway intersection where the A320 was to cross. The controller later stated that, when he issued the takeoff clearance for the B737, he had forgotten that he had instructed the A320 to cross the runway. He was distracted with another duty and neglected to use a locally required memory aid. He worked an evening shift the day prior and reported to work at 0630 on the morning of the incident. During the 9 hours between shifts, he had commuted home, tended to personal activities, then slept 4 hours before returning to work. He reported that he felt "semi-rested" during his shift but was not as sharp as he could have been and did not have coffee.

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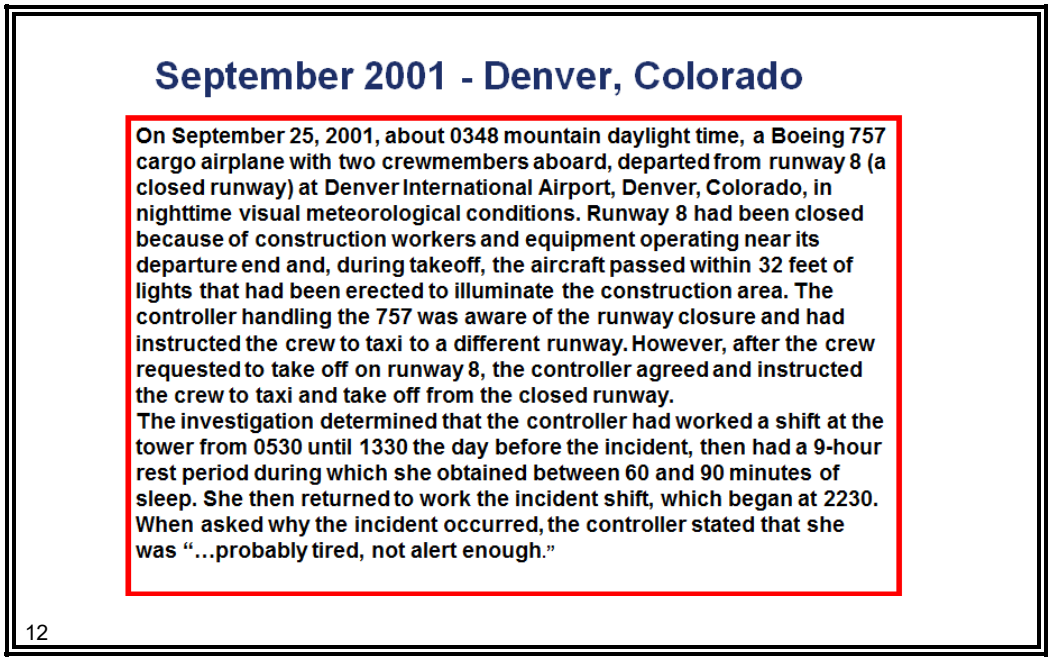
Runway Incursion – Chicago, Illinois

On March 23, 2006, about 0907 central standard time, a controller issued conflicting clearances to two airplanes resulting in a runway incursion at Chicago O'Hare International Airport (ORD). The controller cleared an Airbus A320 passenger airplane to cross runway 4L and, less than 15 seconds later, cleared a Boeing 737 passenger airplane to take off on the same runway. The pilots in the departing 737 observed the A320 moving toward the runway, rejected the takeoff, and stopped before reaching the taxiway intersection where the A320 was to cross.

The controller later stated that, when he issued the takeoff clearance for the 737 he had forgotten that he had instructed the A320 to cross runway 4L. He stated that he was sequencing incoming flight progress strips when he forgot about the crossing clearance and that he had neglected to use a memory aid to remind himself about the crossing traffic, as required by facility operating procedures. The investigation determined that the controller had worked an 8-hour shift the previous day until 2130 and was then off duty for 9 hours. Because of commuting and personal activities, he slept only about 4 hours before returning to work for the incident shift, which began at 0630. He reported that he felt "semi-rested" during his shift but was "not as sharp as [he] could have been." He stated that the second shift had been a quick turnaround with "no coffee."

NTSB ATC FATIGUE CONCERNS *(Continued)*

September 2001 - Denver, Colorado



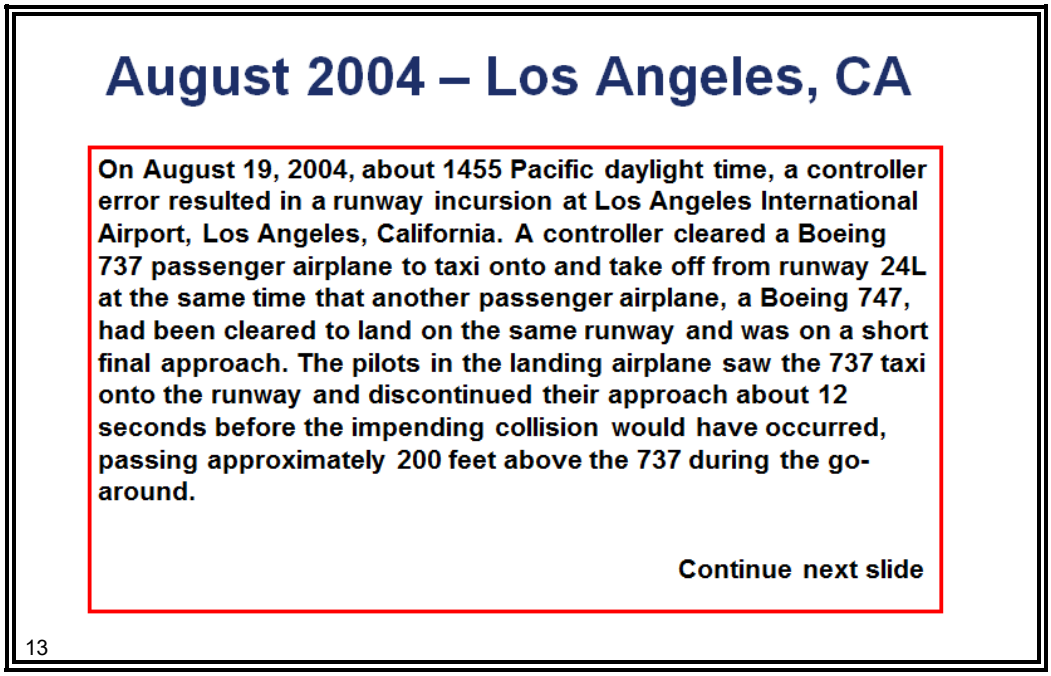
Runway Incursion – Denver, Colorado

On September 25, 2001, about 0348 mountain daylight time, a Boeing 757 cargo airplane with two crewmembers aboard, departed from runway 8 (a closed runway) at Denver International Airport, Denver, Colorado, in nighttime visual meteorological conditions. Runway 8 had been closed because of construction workers and equipment operating near its departure end and, during takeoff, the aircraft passed within 32 feet of lights that had been erected to illuminate the construction area. The controller handling the 757 was aware of the runway closure and had instructed the crew to taxi to a different runway. However, after the crew requested to take off on runway 8, the controller agreed and instructed the crew to taxi and take off from the closed runway.

The investigation determined that the controller had worked a shift at the tower from 0530 until 1330 the day before the incident, and then had a 9-hour rest period during which she obtained between 60 and 90 minutes of sleep. She then returned to work the incident shift, which began at 2230. When asked why the incident occurred, the controller stated that she was "…probably tired, not alert enough."

NTSB ATC FATIGUE CONCERNS *(Continued)*

August 2004 – Los Angeles, CA



Runway Incursion – Los Angeles, CA

On August 19, 2004, about 1455 Pacific daylight time, a controller error resulted in a runway incursion at Los Angeles International Airport, Los Angeles, California. A controller cleared a Boeing 737 passenger airplane to taxi onto and take off from runway 24L at the same time that another passenger airplane, a Boeing 747, had been cleared to land on the same runway and was on a short final approach. The pilots in the landing airplane saw the 737 taxi onto the runway and discontinued their approach about 12 seconds before the impending collision would have occurred, passing approximately 200 feet above the 737 during the go-around.

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NTSB ATC FATIGUE CONCERNS *(Continued)*

August 2004 – LAX (Cont'd)

August 2004 - LAX (Continued)

The investigation determined that when the controller began working the local control position, he received a correct position-relief briefing that the 747 was approaching runway 24L. The controller later indicated that he subsequently developed a mistaken belief that the 747 was landing on the adjacent parallel runway 24R. The investigation determined that the controller had worked a shift the previous evening from 1530 until 2330, then went home and slept between 5 and 6 hours before returning to work the incident shift, which began at 0730. The controller described the portion of his shift before the incident as a "hard day" and attributed his error, in part, to fatigue.

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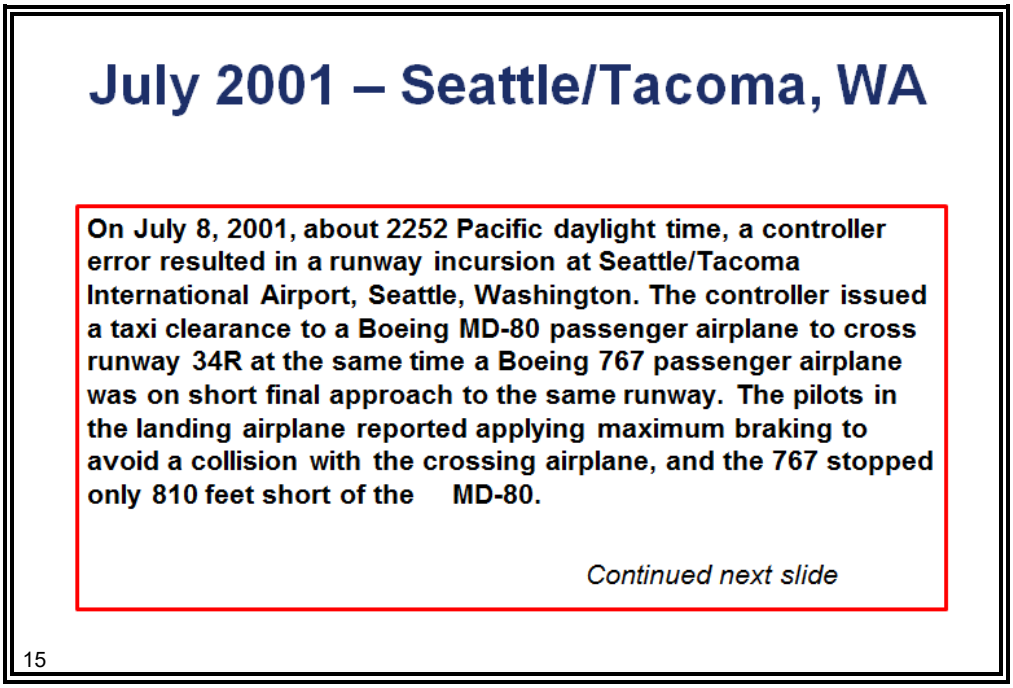
Runway Incursion – Los Angeles, CA (Cont'd)

The investigation determined that when the controller began working the local control position, he received a correct position-relief briefing that the 747 was approaching runway 24L. The controller later indicated that he subsequently developed a mistaken belief that the 747 was landing on the adjacent parallel runway 24R. The investigation determined that the controller had worked a shift the previous evening from 1530 until 2330, then went home and slept between 5 and 6 hours before returning to work the incident shift, which began at 0730. The controller described the portion of his shift before the incident as a "hard day" and attributed his error, in part, to fatigue.

NTSB ATC FATIGUE CONCERNS *(Continued)*

July 2001 - Seattle/Tacoma, WA



Runway Incursion – Seattle/Tacoma, WA

On July 8, 2001, about 2252 Pacific daylight time, a controller error resulted in a runway incursion at Seattle/Tacoma International Airport, Seattle, Washington. The controller issued a taxi clearance to a Boeing MD-80 passenger airplane to cross runway 34R at the same time a Boeing 767 passenger airplane was on short final approach to the same runway. The pilots in the landing airplane reported applying maximum braking to avoid a collision with the crossing airplane, and the 767 stopped only 810 feet short of the MD-80.

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NTSB ATC FATIGUE CONCERNS *(Continued)*

July 2001 – SEA/TAC (Cont'd)

July 2001 – SEA/TAC (Continued)

The investigation determined that the controller had assumed responsibility for his position shortly before the incident and had received a position-relief briefing addressing all applicable traffic, including the landing 767. However, the controller forgot about that airplane and did not identify its presence on short final approach because he did not perform the required visual scan of the runway and its approach area before he issued the runway crossing clearance. The investigation determined that, on the night of the incident, the controller was working his third shift in 2 days, with an 8-hour rest period between shifts. The day before the incident, the controller worked from 1400 to 2200, slept between 4 and 5 hours at home, worked from 0555 to 1355 the day of the incident, slept 3 hours at home, then returned to work the incident shift, which began at 2245. The controller stated that he tried to avoid midnight shifts whenever possible because of fatigue and said that, at the time of the incident, he was feeling tired, in part because he knew he "…had to be up all night long on a double quick turnaround."

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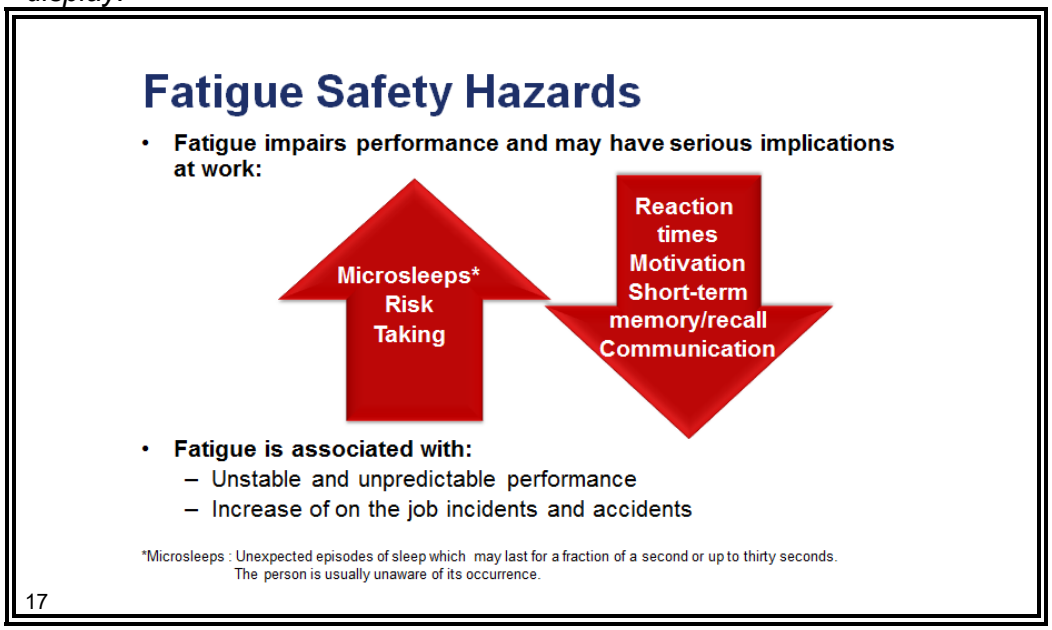
Runway Incursion – Seattle/ Tacoma, WA (Cont'd)

The investigation determined that the controller had assumed responsibility for his position shortly before the incident and had received a position-relief briefing addressing all applicable traffic, including the landing 767. However, the controller forgot about that airplane and did not identify its presence on short final approach because he did not perform the required visual scan of the runway and its approach area before he issued the runway crossing clearance. The investigation determined that, on the night of the incident, the controller was working his third shift in 2 days, with an 8-hour rest period between shifts. The day before the incident, the controller worked from 1400 to 2200, slept between 4 and 5 hours at home, worked from 0555 to 1355 the day of the incident, slept 3 hours at home, then returned to work the incident shift, which began at 2245. The controller stated that he tried to avoid midnight shifts whenever possible because of fatigue and said that, at the time of the incident, he was feeling tired, in part because he knew he "…had to be up all night long on a double quick turnaround."

FATIGUE SAFETY HAZARDS

☞ ***NOTE:*** *PowerPoint presentation: There are 3 transitions in this presentation. The title, the arrows, and the asterisked text are displayed first; click, the first bulleted text displays; click, the second bullet and sub-bullets display.*

Fatigue Safety Hazards



Overview

- The red arrows indicate factors that either decrease or increase as a result of fatigue.
- Fatigue impairs performance and may have serious implications at work, impairing judgment and the ability to think clearly.

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FATIGUE SAFETY HAZARDS *(Continued)*

Overview (Cont'd)

- Fatigue safety hazards:
  - Microsleeps:
    - Are brief periods of sleep that may come on unexpectedly when someone has not received adequate rest
    - This abrupt nodding off is the body's way of inducing much needed rest and is especially dangerous because it may occur without warning.
    - As many as 80% of workers who work round-the-clock shifts have experienced microsleeps.
  - Risk taking:
    - People are more likely to commit errors and engage in risky behavior when they are fatigued.
  - Reaction/response time:
    - Fatigue also compromises the ability to react quickly to situations and to communicate effectively.
    - A fatigued person is less likely than a rested person to be able to respond immediately or communicate important information effectively.
  - Motivation
  - Short term memory/recall
  - Communication

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FATIGUE SAFETY HAZARDS *(Continued)*

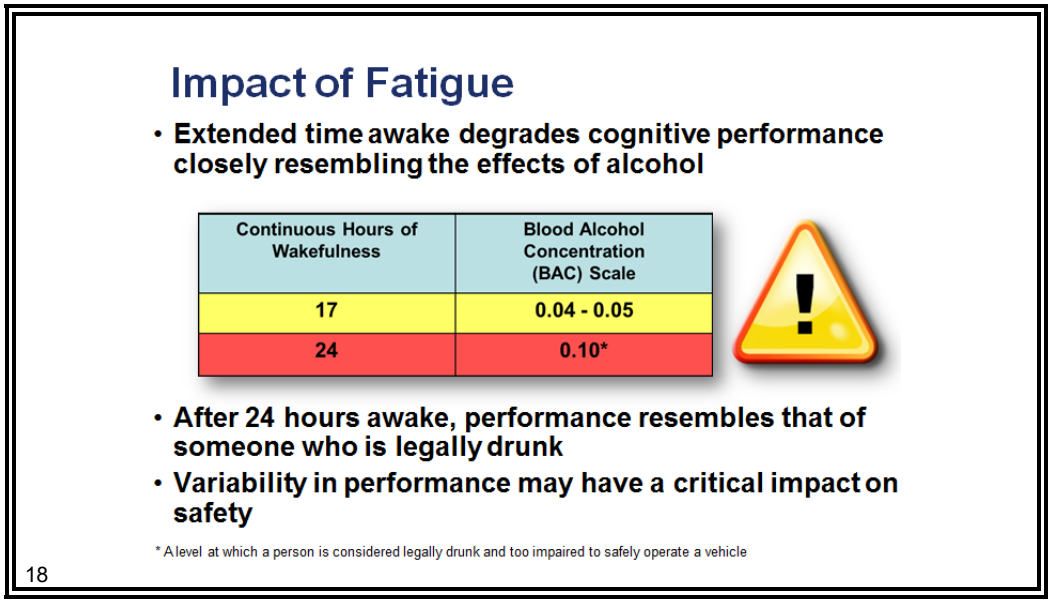
Overview (Cont'd)

- Fatigue is associated with the following:
  - Unstable and unpredictable performance
    - Fatigued performance is best described as unstable.
    - When fatigued, individuals tend to perform reasonably well in many respects, but will often exhibit lapses in performance that include:
      - → performing the wrong action
      - → failing to perform the correct action
    - When occurring within otherwise good performance, these lapses can often go unnoticed not only by the person who is fatigued, but also by those with whom they work.
    - Clearly this could pose a serious problem when operating machinery or performing some other safety-critical task.
- Increase of on-the-job incidents and accidents.
  - Fatigue in the workplace can be a serious safety hazard and is often linked to workplace errors and accidents.
    - A notable is the nuclear reactor meltdown at Chernobyl where the lack of action by workers led to hundreds of deaths, cancer, subsequent birth defects, and billions of dollars in recovery efforts.

IMPACT OF FATIGUE

☞ ***NOTE:*** *PowerPoint presentation: There are 4 transitions in this presentation. The title, the graphics, and the asterisked text are displayed first; click, the first bullet is displayed, click, the third bullet is displayed, click last bullet is displayed.*

Impact of Fatigue



Overview

- ⊙ The impact of fatigue is serious.
- ⊙ Extended time awake degrades cognitive performance closely resembling the effects of alcohol.
  - After 17 hours awake, performance resembles that of someone who has a blood alcohol concentration (BAC) of 0.04 – 0.06
  - After 24 hours awake, performance resembles that of someone who is legally drunk or more equals a BAC of 0.10.
    - A level at which a person is considered legally drunk and too impaired to safely operate a vehicle.
      - → .08 is legally drunk in Oklahoma
- ⊙ This means RISK.

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IMPACT OF FATIGUE *(Continued)*

Overview (Cont'd)

- ⊙ Variability in performance may have a critical impact on safety.
  - The variability in performance refers to unpredictability.
    - The person may perform normally, and then suddenly, without notice, there is a lapse in attention for a second or two or more, then back to performing normally, then a lapse in attention, etc.

      → These "microsleeps" are where the safety risk increases!
  - When fatigued, individuals tend to perform reasonably well in many respects, but will often exhibit lapses in performance that include performing the wrong action or failing to perform the correct action.

REVIEW

☞ ***NOTE:*** *PowerPoint presentation: There are 7 transitions in this presentation. The title is displayed first; the remaining 6 transitions display each statement.*

True or False?

True or False?

- I know when I am fatigued
- With enough will-power I can push through
- All I need is some caffeine to keep me going
- People need less sleep as they age
- Drinking alcohol before bed helps you sleep
- Naps don't really help

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Response

☞ ***NOTE:*** *Listed below is some expanded background on why each statement is false.*

⊙ I know when I'm feeling fatigued. ***Answer: FALSE***

- People are generally very poor judges of their own fatigue, especially when they are fatigued!
- When people self-report fatigue they are referring to subjective fatigue, or how they feel, not the physiological fatigue.
- Physiological fatigue generally precedes subjective fatigue and is the component that primarily affects performance.
- This means that people are often more fatigued than they realize.

Continued on next page

REVIEW *(Continued)*

Response (Cont'd)

⊙ With enough will-power I can push through fatigue. ***Answer: FALSE***

- Fatigue involves a physiological component that is dependent on sleep, or the lack of sleep, and the body's natural circadian rhythm of sleepiness.
- No amount of will-power will help to overcome this aspect of fatigue; it just helps you to ignore the signs and symptoms.
- Fatigue causes reductions in alertness and performance that are unavoidable – whether you recognize them or not.

⊙ All I need is some caffeine to keep me going. ***Answer: FALSE***

- Using caffeine has been shown to be an effective short term countermeasure for increasing alertness and reducing subjective fatigue.
- You may feel a little better and may be able to ignore the signs and symptoms for a while longer, but in the end you're still fatigued and the effects of caffeine will dissipate over time.
- Caffeine is only a short-term solution and becomes less effective when over-used.

⊙ People need less sleep as they age. ***Answer: FALSE***

- While it is true that older adults often spend less time in the deep stages of sleep and find sleep less restful, it's because they tend to have difficulty sleeping, often wake in the middle of the night or in the early morning.
- There is no evidence to suggest that adults need less sleep as they age.
  - Rather, the sleep stages change as we age, so we don't get as much restful sleep.

Continued on next page

Response (Cont'd)

⊙ Drinking alcohol before bed can help you sleep. ***Answer: FALSE***

- Alcohol can help you relax, to some extent, and makes it easier for you to fall asleep because of its sedating effects.
  - As alcohol wears off, you are much more likely to wake during the night and be less able to return to sleep.
- It's also problematic because alcohol can significantly disrupt sleep without waking the person.
- So you may think that you are getting a good night's sleep and have no idea that the alcohol is actually keeping you from getting truly restorative sleep.

⊙ Naps don't really help. ***Answer: FALSE***

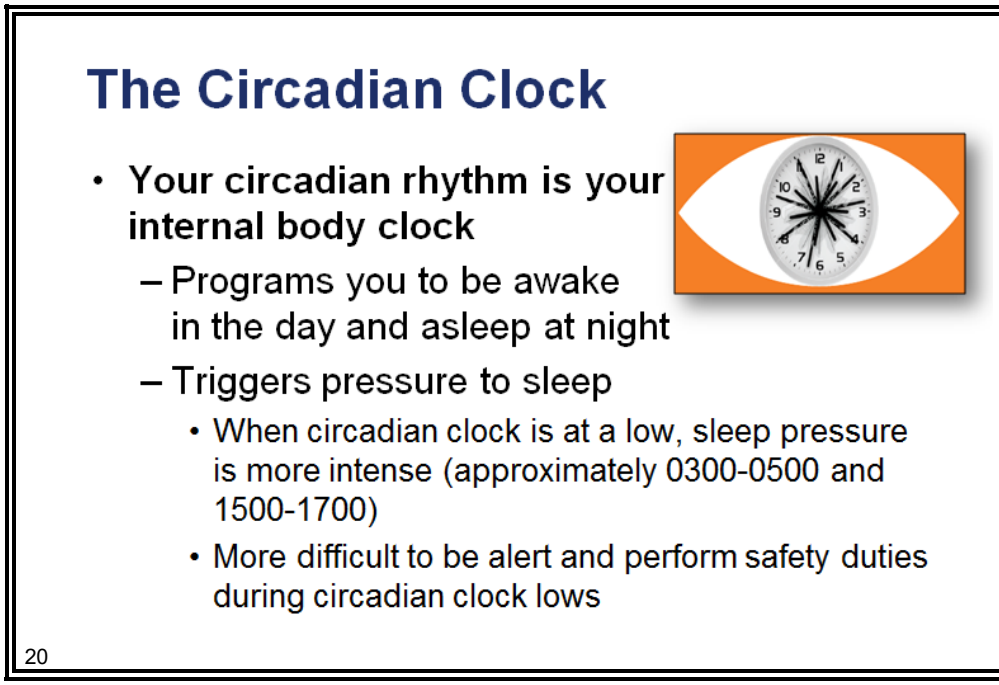
- Unfortunately, some people believe that short naps of 10 to 15 minutes are not useful for restoring alertness, or that they actually make you more tired.
  - This is not the case. Even a 10 minute nap can provide a marked improvement in alertness and performance.
    - → Any sleep helps
  - As for feeling more tired after a nap, that groggy feeling is common after sleep and typically wears off in 15 to 20 minutes.
    - → It can be more pronounced if you have not had a lot of sleep in the previous days.
    - → Once that groggy feeling wears off, people demonstrate improvement in their level of alertness.
    - → Some sleep is always better than no sleep.

☞ ***NOTE:*** *Hand out the "How to Nap – Boston Globe" flyer.*

THE CIRCADIAN CLOCK

☞ ***NOTE:*** *PowerPoint presentation: There are 3 transitions in this presentation. The title and graphic is displayed first; click, the first bullet and first set of text are displayed; click and the second set of text is displayed.*

The Circadian Clock



Overview

⊙ Your circadian rhythm is your internal body clock.

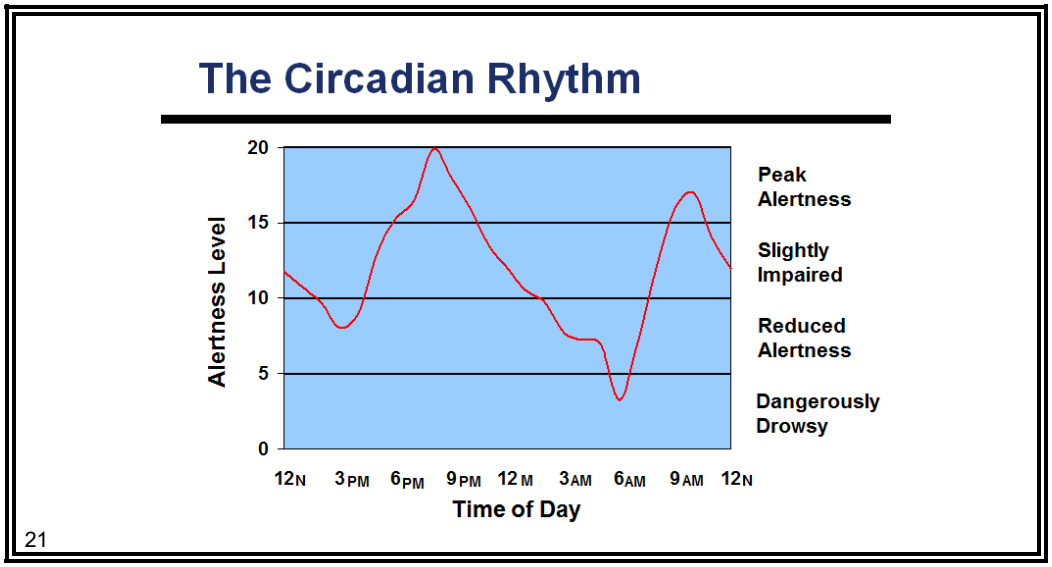
- Disruption of the circadian clock is a primary fatigue factor.
- Programs you to be awake in the day and asleep at night.
- Triggers pressure to sleep.
  - When your circadian clock is at a low, sleep pressure is more intense (approximately 0300-0500 and 1500-1700)

⊙ Do you ever wonder why you are sleepy after lunch?

- Most blame it on food, but quite likely, it's a "low" in your circadian clock telling you it is time to sleep.
- It is set by daylight, which is why it is hard to sleep during the day. A big challenge when working midnight shifts.

CIRCADIAN RHYTHM DRIVES ALERTNESS

The Circadian Rhythm



Overview

- The internal body clock (circadian clock) has rhythms that drive alertness at certain times of the day and night.
  - The red-line on this chart shows that rhythm.
  - The peaks show when the body is naturally more alert.

☞ ***INSTRUCTOR NOTE:*** *See the highest peak around 9 PM?*

☞ ***QUESTION:*** *How would this impact your attempts to go to sleep at 9PM when you have an early morning shift?*

Your body says, "Hey, I'm at an alertness peak here! I don't want to sleep!"

- When the rhythm shown by the red line dips, alertness takes a dive too and can impact performance.

☞ ***QUESTION:*** *Have you noticed around 3 PM that your alertness level dips? It is not necessarily due to eating too many carbs at lunch! Your circadian rhythm is dipping so you get a little drowsy.*

- The same is true for a couple of hours after 3 AM. See the lowest dip on the red-line on the chart around 3-5 AM.

☞ ***QUESTION:*** *How could this impact safety decisions?*

Continued on next page

CIRCADIAN RHYTHM DRIVES ALERTNESS *(Continued)*

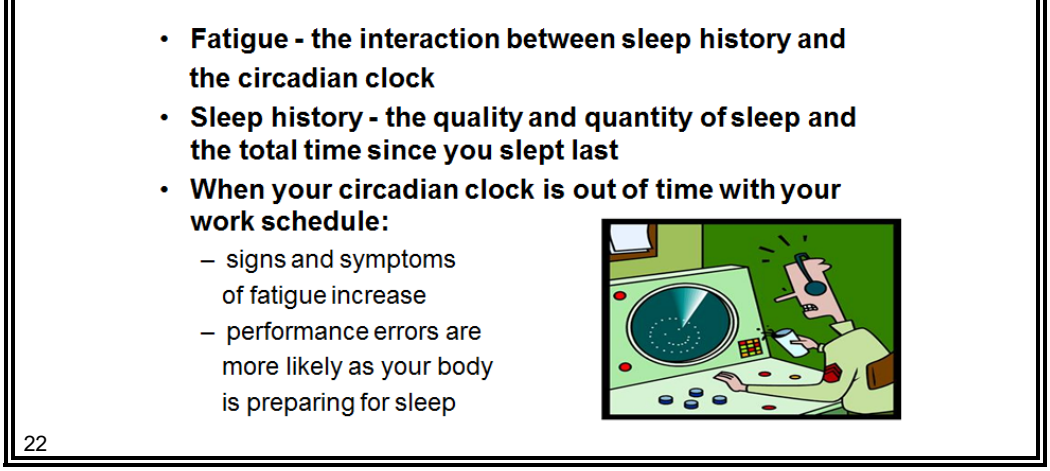
Overview (Cont'd)

- The chart shows the highs and lows of the circadian rhythm for alertness.
  - Labels for the corresponding levels of alertness that people experience throughout the day and night are shown on the right.
  - 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 around 9:00pm, then another decline that reaches its low between 3:00am and 6:00am.
  - The dip in the early morning hours coincides with our minimum body temperature and is called the nadir.
  - It is also called the window of circadian low or WOCL.
  - The lesser dip in the afternoon has been called the post-lunch-slump or the secondary WOCL.
  - It has nothing to do with what you ate for lunch. It's part of your normal circadian rhythm.
- The early morning hours are when you're more likely to be a danger to yourself and others.
  - Awareness of this effect can help you to strategically mitigate your diminished alertness with appropriate countermeasures (caffeine intake, nap, bright lights, etc.).
- Even if you've been working on the midnight shift and experiencing significant fatigue and diminished alertness, you will experience a rise in alertness in the morning with a peak around 10:00 am based solely on your circadian rhythm.

THE CIRCADIAN CLOCK AND SLEEP LOSS

☞ ***NOTE:*** *PowerPoint presentation: There are 3 transitions in this presentation. The title, the first 3 bulleted text and the and graphic is displayed first; click, the fourth line of text is displayed, click the last line of text is displayed*

The Circadian Clock and Sleep Loss



Overview

- ⊙ Fatigue
  - The interaction between sleep history and the circadian clock.
- ⊙ Sleep history
  - The quality and quantity of sleep and the total time since you slept last.
- ⊙ When your circadian clock is out of time with your work schedule:
  - Signs and symptoms of fatigue increase.
  - Performance errors are more likely as your body is preparing for sleep.

INSTRUCTOR-LED DISCUSSION

Discussion

QUESTION: How many of you are going to work at a 24 hour facility?

☞***NOTE:*** *Discuss with the student's their responses.*

QUESTION: Has anyone stayed awake all night?

☞***NOTE:*** *Discuss with the student's their responses.*

QUESTION: How did you feel?

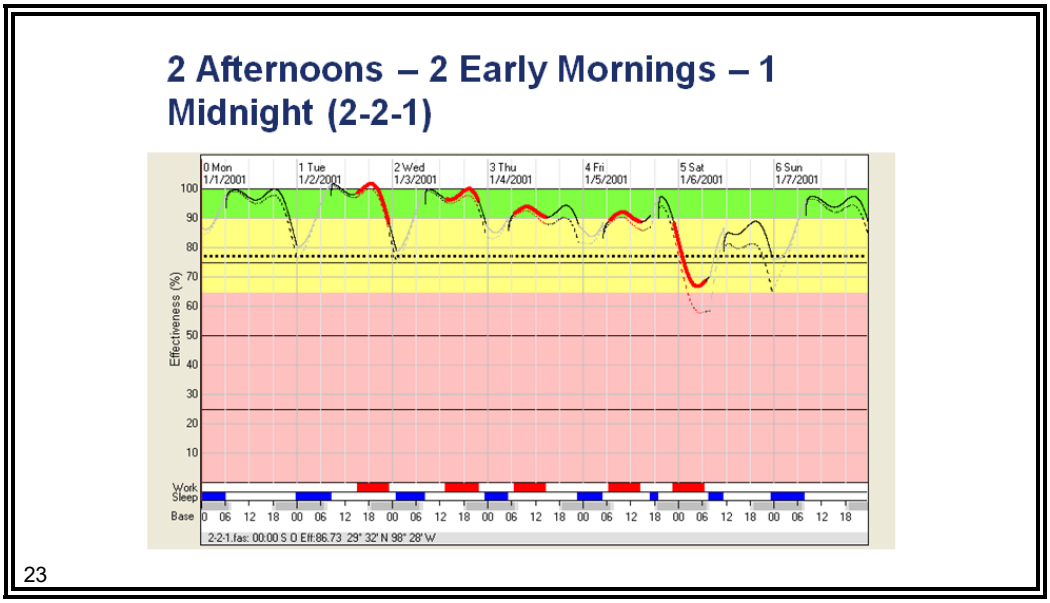
☞***NOTE:*** *Discuss with the student's their responses.*

Overview

- ⊙ It is critical to plan your sleep so you can be rested for all shifts, especially midnight shifts.
- ⊙ Jet lag is a good is another good example of how you feel when your circadian clock is out of sync with your schedule.

2 AFTERNOONS – 2 EARLY MORNINGS – 1 MIDNIGHT (2-2-1)

2 Afternoons – 2 Early Mornings – 1 Midnight (2-2-1)



Fatigue Avoidance Scheduling Tool

- This graphic represents the output of the Fatigue Avoidance Scheduling Tool (FAST)
  - There is a predictive fatigue model called the Sleep, Activity, and Task Effectiveness (SAFTE) model that runs in the background and determines the variable predicted performance effectiveness seen as the multi-colored line at the top of the figure.

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2 AFTERNOONS – 2 EARLY MORNINGS – 1 MIDNIGHT (2-2-1) *(Continued)*

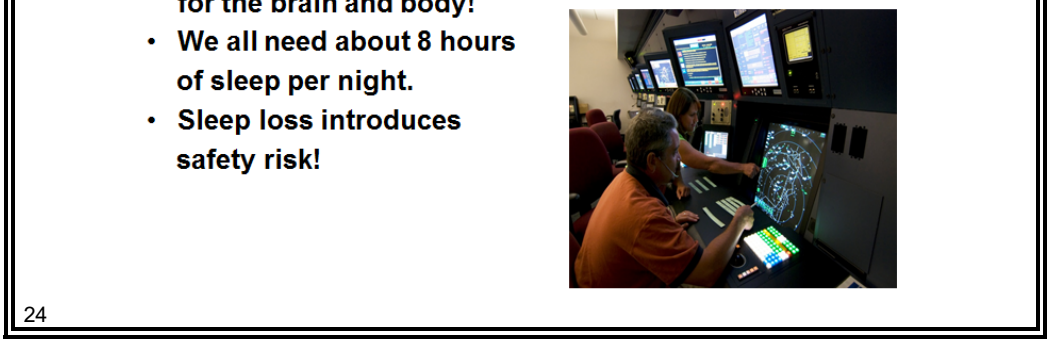
2 Afternoons – 2 Early Mornings – 1 Midnight (2-2-1) (Cont'd)

- The output predictions of Performance Effectiveness, in percentage, are based on entries of sleep and work, seen along the bottom axis in blue and red, respectively, as they occur during each 24-hour period.
  - The graphic shown here depicts the Performance Effectiveness predictions at the top of the chart, reflecting a somewhat typical ATC 2-2-1 shift rotation schedule.
  - The schedule begins with two afternoon shift workdays (1400-2200), followed by two early morning shifts (0600-1400), and followed by a midnight shift (2200-0600), all within 4 days.
    - The quick rotation to early mornings provides only 8 hours between shifts (however, now it's regulated at 9 hours) and you can see a significantly reduced performance effectiveness prediction for those two days because of time-of-day and restricted sleep that typically occurs with this type of quick-turn rotation.
    - After the second early morning shift, there is another quick turn rotation of 8 hours before beginning the midnight shift at 2200.
    - Because we are not able to sleep well, or for very long during the daytime, the sleep shown here is typical only 2.5-3.0 hours in the afternoon.
- Working the midnight shift when your body clock says you should be sleeping, is very difficult and as you can see in the last red line representing this shift.
  - Performance effectiveness is significantly affected with a drastic down-turn in the curve.
  - This is a time when fatigue-related risk is at its greatest and a period of time that you need to take care in mitigating your fatigue with appropriate countermeasures promoting more alertness.
- This graphic is important to understand, in that you can see that shiftwork (i.e., the start/end times of your shift) are critical in affecting levels of fatigue experienced by controllers on a routine basis.

SLEEP BASICS

☞ ***NOTE:*** *PowerPoint presentation: There are 5 transitions in this presentation. The title` and the graphic are displayed; the remaining 4 transitions display each bulleted line of text.*

Sleep Basics



Overview

⊙ We just learned how fatigue manifests operationally. Now we will see how sleep loss is a primary contributor to fatigue.

- Like air, food and water, sleep is a basic need for health and survival.
- Sleep is the antidote to fatigue and it is restorative for the brain and body.
- We all need about 8 hours of sleep per night.
- Sleep loss introduces safety risk.

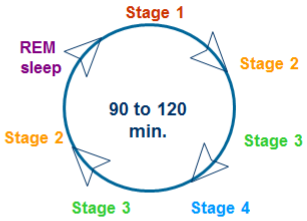
SLEEP PROCESS

☞ ***NOTE:*** *PowerPoint presentation: There are 7 transitions in this presentation. The title and the graphic are displayed first; the remaining 6 transitions display each bulleted line of text.*

Sleep Process - nREM and REM

Sleep Process – nREM and REM

- **nREM (non-Rapid Eye Movement):**
  - Cycle through 4 stages of sleep every 90-120 minutes
  - *Stage 1* - drowsy, relaxed state between being awake & sleeping - breathing slows, muscles relax, heart rate drops
  - *Stage 2* - slightly deeper – may feel awake; may be asleep & not know it



Stage 3 & 4 - Deep Sleep, least body activity, hardest to awaken

Cycle back - to Stage 2 for a few minutes, then to REM (Rapid Eye Movement) sleep (dream sleep)

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☞ ***NOTE:*** *This will make more sense when students understand the importance of the sleep process in the next slide –* ***Consolidated Sleep Period.***

Sleep Process

⊙ The graphic shows information on what is going on when you sleep.

- It shows the cyclic nature of our sleep process:
  - Differences in each of the sleep phases
  - How sleep contributes to the restoration of physical and mental functioning.

☞ ***NOTE:*** *This will make more sense once you understand the importance of the sleep process (on the next slide).*

⊙ Time awake and time asleep are primary fatigue factors.

- Sleep fights fatigue

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SLEEP PROCESS *(Continued)*

Sleep Process (Cont'd)

- Background on the sleep process:
  - The process of sleep is actually a cycle that lasts approximately 90 to 120 minutes and is repeated throughout the entire sleep period.
  - The last cycle of the night is often incomplete due to waking up by an alarm clock or other outside stimuli.
- Even if you're not able to complete a cycle, sleep is still beneficial.
- Also, people often don't progress through the cycle exactly as we describe it, but this is a useful way to think about the process that is taking place.
- It's important to realize that all sleep is restorative, and that the sleep process is adaptive.
  - If you don't get enough of one stage of sleep during a sleep period, your body will compensate during the next sleep period and increase the stage that you are short on.
- Phases of the sleep cycle are:
  - non-Rapid Eye Movement sleep or nREM
  - Rapid Eye Movement sleep or REM
- Both phases are necessary in order for you to feel rested and for learning and memory consolidation, but they also differ in some important ways.

Continued on next page

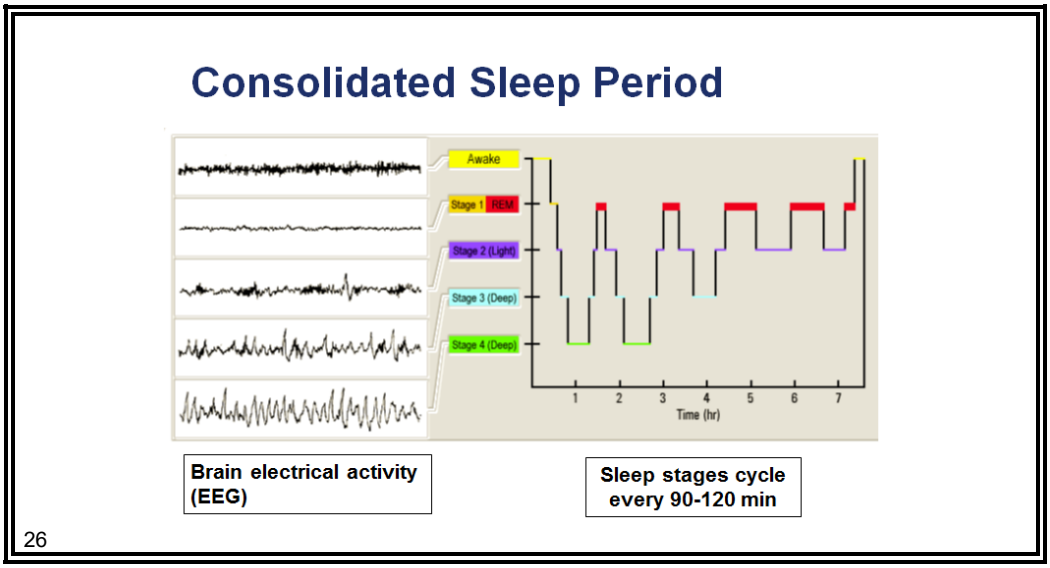
SLEEP PROCESS *(Continued)*

Sleep Process (Cont'd)

- ⊙ The first phase is nREM, which is a time of decreased physiological and mental activity by the body.
  - This phase consists of four stages:
    - Stage 1: Drowsy, relaxed state between being awake and sleeping. Breathing slows, muscles relax, heart rate drops
    - Stage 2: Slightly deeper sleep. May feel awake, but asleep and not know it.
    - Stage 3 and 4: Deep sleep, least body activity, hardest or most difficult to awaken.
      - → These stages are when the truly restorative sleep is attained and when you're likely to feel particularly groggy if awakened.
      - → This groggy feeling is known as sleep inertia and typically lasts for 15-20 minutes after waking.
      - → During this time it is important not to perform safety critical tasks such as driving a car or operating machinery.
  - As the body progresses through all four stages, breathing slows and muscle tension eases.
- ⊙ The sleep process "Cycles" back to stage 2 for a few minutes, then to REM sleep (dream sleep).
- ⊙ The second phase is REM.
  - During this phase, physiological and mental activity increase and the brain becomes very active.
  - This is also the phase during which people dream and if awakened during this time, are more likely to be able to recall their dreams.

CONSOLIDATED SLEEP PERIOD BENEFITS

Consolidated Sleep Period



Consolidated Sleep Period Benefits

☞ ***INSTRUCTOR NOTE:*** *This graphic shows information on how your body goes through sleep stages that cycle every 11/2-2 hours during the night.*

- Different stages of sleep have difference benefits
  - A whole night's sleep is needed to get those benefits.
- During early stages of a night's sleep, brain activity shows slow (deep) waves.
  - During this sleep biological functions are restored.
  - During stages later in the night such as REM sleep, memory and other mental functions are restored.
- When you get a full night's sleep, you go through sleep stages fully and get their important benefits.

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CONSOLIDATED SLEEP PERIOD BENEFITS *(Continued)*

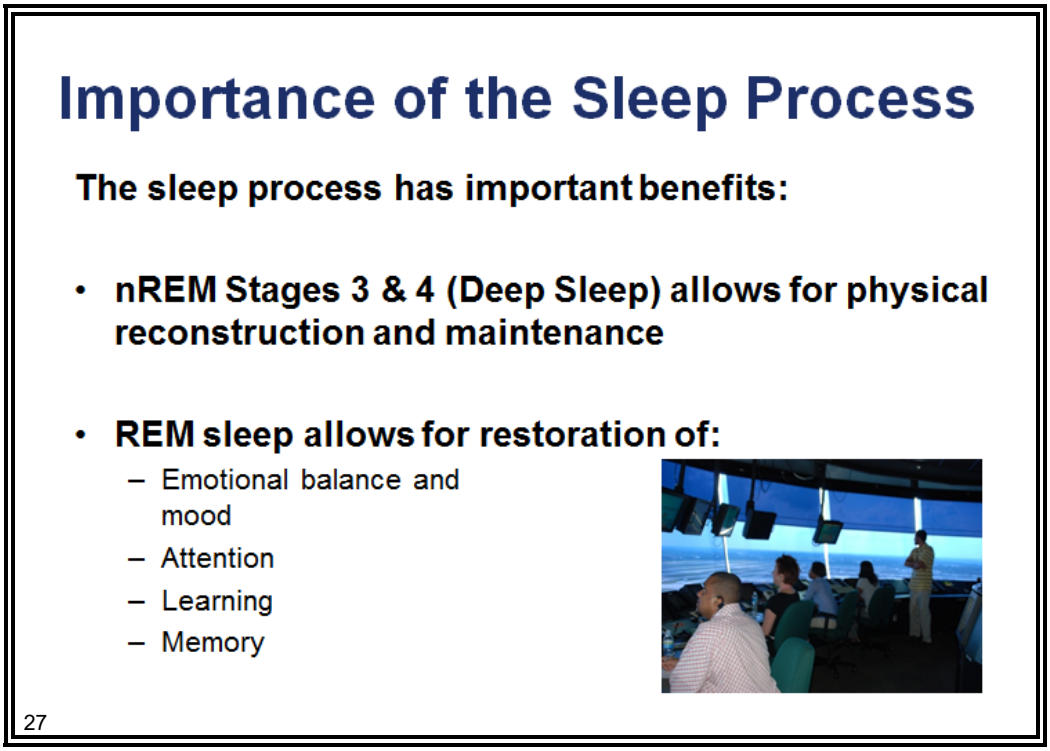
Consolidated Sleep Period Benefits (Cont'd)

- This graphic shows what the Electroencephalography (EEG) signals look like for each stage of sleep (on left).
  - An EEG is a test that measures and records the electrical activity of the brain.
- The right side shows the different stages of sleep and how the sleep cycle changes every 90 to 120 minute throughout the sleep period.
  - Notice that people spend more time in stages 3 & 4, or slow wave sleep during the beginning of the sleep period and with an increasing amount of time in REM sleep during the latter part of the sleep period.
  - This cyclic pattern of sleep is not found during daytime sleep.
  - The sleep architecture may reflect differences in the variable amount of sleep time experienced during the day.
- Daytime sleep is generally split with 3-4 hours occurring between 0600-noon, and another sleep period of 2-3 hours during the middle of the afternoon coinciding with the secondary WOCL, or split again with another 2 hours or so during the early evening before our second peak of alertness found in our circadian rhythm.
- Slow wave sleep (stages 3 & 4) provides more physical/physiological recovery with memory and other cognitive function recovery occurring during REM sleep.
- Remember, alcohol ingestion disrupts REM sleep and reduces the quality of your sleep.

IMPORTANCE OF THE SLEEP PROCESS

☞ ***NOTE:*** *PowerPoint presentation: There are 4 transitions in this presentation. The title and the graphic are displayed first; the remaining 3 transitions display each bulleted line of text.*

Importance of the Sleep Process



Overview

- ⊙ The sleep process has important benefits.
  - nREM stages 3 and 4 (deep sleep)
    - allows for physical reconstruction and maintenance
  - REM sleep allows for the restoration of the following:
    - Emotional balance and mood
    - Attention
    - Learning
    - Memory
  - Consolidation of memory does not happen efficiently when under influence of alcohol.

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IMPORTANCE OF THE SLEEP PROCESS *(Continued)*

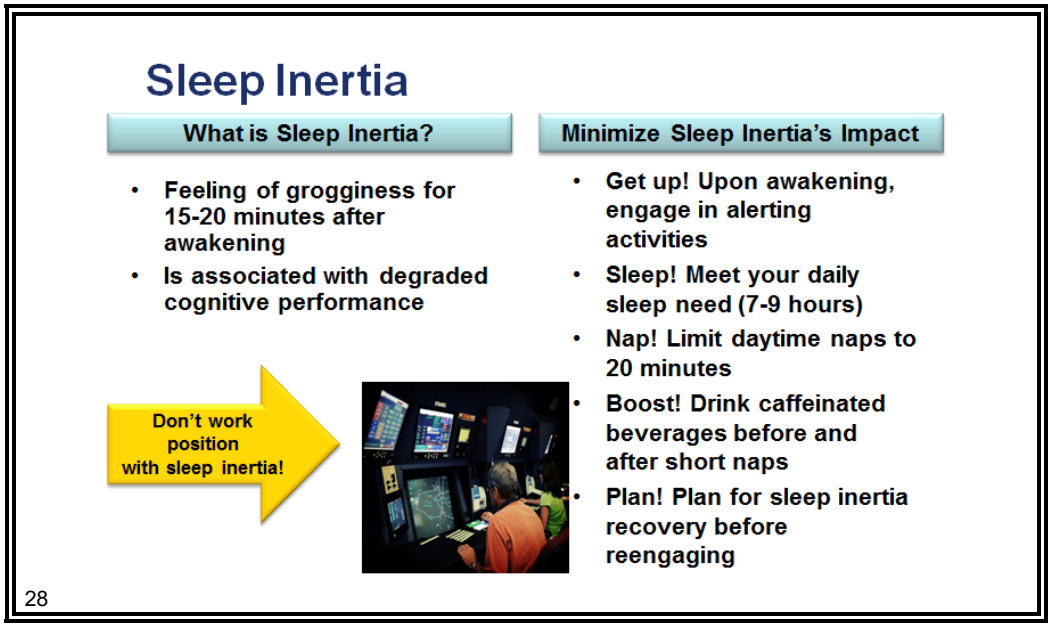
Overview (Cont'd)

- The bottom line is that you understand the benefits of the sleep process for safety as well as for your health and well-being.
- Control positions rely on interaction with pilots as well as other controllers.
  - Imagine the adverse impact of necessary teamwork if everyone on the team missed their REM sleep?
  - Emotions and mood might be at a low, and inattentiveness might be high.

SLEEP INERTIA

☞ ***NOTE:*** *PowerPoint presentation: There are 9 transitions in this presentation. The titles and the graphic are displayed first; the remaining 7 transitions display each bulleted line of text; the last transition displays the arrow.*

Sleep Inertia



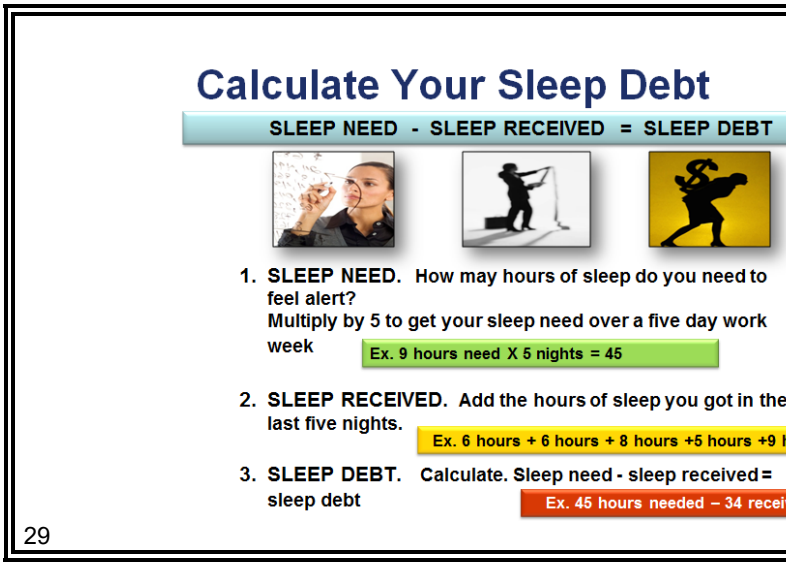
Overview

- What is Sleep Inertia?
  - Feeling of grogginess for 15-20 minutes after awakening
  - Is associated with degraded cognitive performance
- Minimize Sleep Inertia's impact by:
  - Getting up: Upon awakening engage in altering activities
  - Getting enough sleep: Meet your daily sleep need (7-9 hours)
  - Taking a nap: Limit daytime naps to 20 minutes
  - Getting a boost: Drink caffeinated beverages before and after short naps
  - Planning: Plan for sleep inertia recovery before reengaging

CALCULATE YOUR SLEEP DEBT

☞ ***NOTE:*** *PowerPoint presentation: There are 7 transitions in this presentation. The titles and the graphic are displayed first; the remaining 7 transitions display each numbered line of text followed by an example.*

Calculate Your Sleep Debt



Overview

- Sleep need minus sleep received equals sleep debt
  - Sleep need. How many hours of sleep do you need to feel alert?
    - multiply by 5 to get your sleep need over a five day work week

      Example: 9 hours needed, times 5 nights equals 45
  - Sleep received. Add the hours of sleep you received in the last five nights.

    Example: 6 hours + 6 hours +8 hours + 5 hours + 9 hours = 34 hours
  - Sleep debt. Calculate: Sleep need minus sleep received equals sleep debt

    Example: 45 hours needed minus 34 equals 11 hours of sleep debt.
- If the sleep debt number is above zero, that number is the number of hours the person needs recover.
- If the sleep debt number is less than zero: congratulations! It appears you are getting the sleep you need.

EXERCISE

Exercise

QUESTION: Using the formula you were just taught, calculate your sleep debt for the last 3 nights?

How many hours of sleep do you need per night?

How many hours of sleep would you need for 3 days?

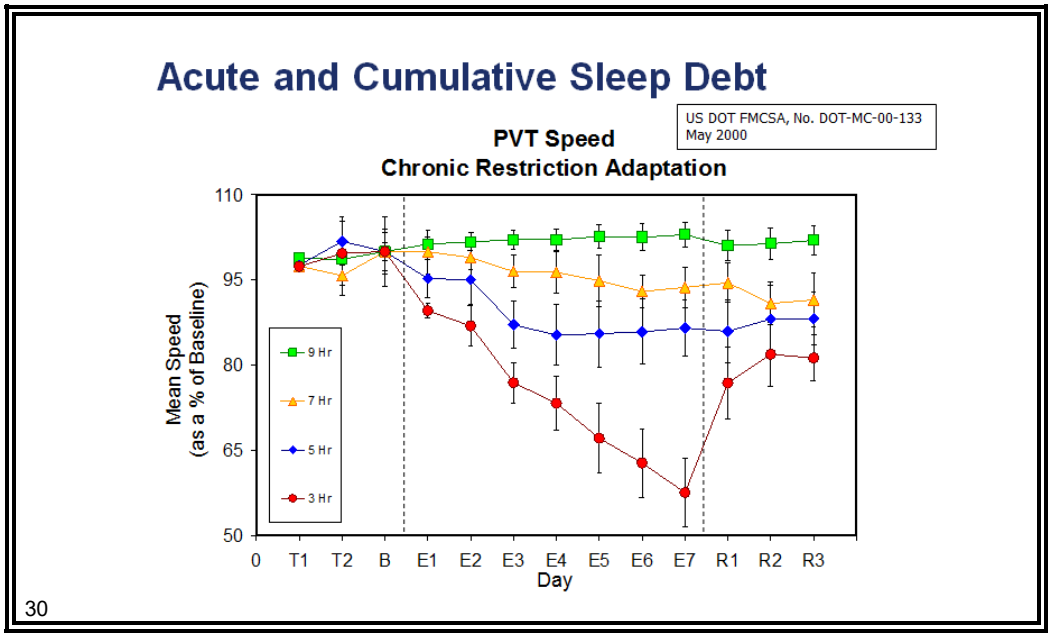
How many hours of sleep have you had in the past 3 nights?

What is your sleep debt?

☞ ***NOTE:*** *Discuss with the student's their responses.*

SLEEP DEBT IMPACTS PERFORMANCE

Acute and Cumulative Sleep Debt



Sleep Debt Impacts Performance

- The graph plots the results of a scientific study on sleep debt and cognitive (mental) recovery.
  - The more sleep debt the person has, the slower their response times were tested.
  - Sleep debt slows you down.
    - Not a good thing when you are working air traffic and need to be sharp and keep the pace!
- The study showed how even one hour less sleep per night impacts performance!
- It is critical if you accumulate sleep debt that you use recovery sleep on your days off as much as possible to overcome it.

SLEEP DEBT IMPACTS PERFORMANCE *(Continued)*

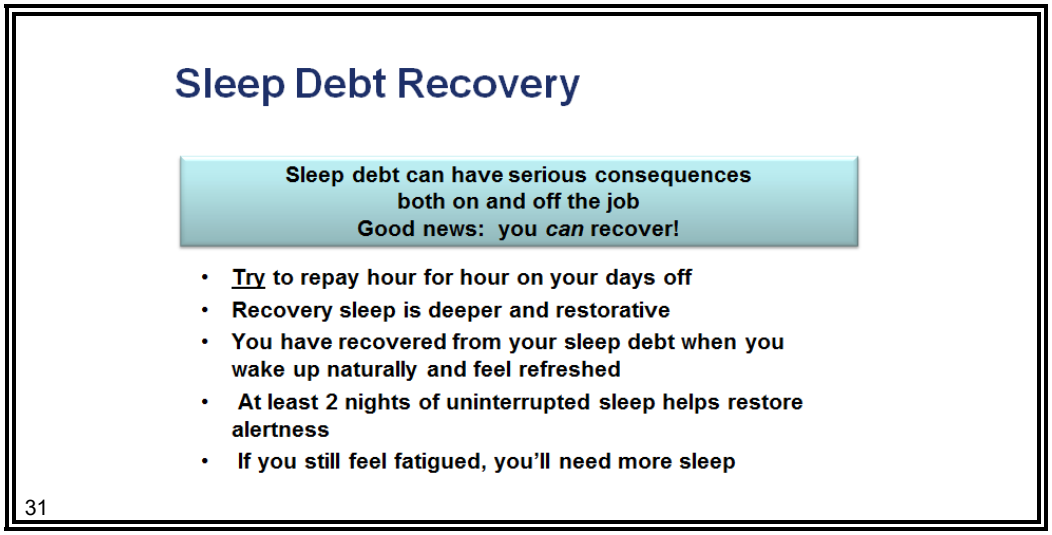
Recovery Sleep

- The **'Acute and Cumulative Sleep Debt'** graphic shows response speed as it changes over the course of a sleep restriction experiment.
- It also shows both the effects of acute (short-term) and cumulative (longer-term) sleep debt.
- T1-T2 refers to training days followed by the B or Baseline measure. E1-E7 refers to experimental days, whereby performance speed is portrayed for different groups of participants receiving different amounts of sleep time per night
- The 9 Hr group was allowed to sleep an extra hour per night.
- The 7 Hr group was restricted to 7 hours per night.
- The 5 Hr group was restricted to 5 hours per night and the 3 Hr group was only allowed to sleep 3 hours per night.
- The 7 Hr group, with only one hour less sleep than the normal 8, shows significant performance degradation over the week, and probably more importantly, after 8 hours of sleep per night on the R1-R3 recover nights, performance did not return to baseline levels!!
- This is truer for the 5 and 3 hour per night groups.
    - This indicates that 8 hours per night following accumulated sleep loss (sleep debt) in not sufficient for recovery.

SLEEP DEBT RECOVERY

☞ ***NOTE:*** *PowerPoint presentation: There are 6 transitions in this presentation. The titles and the graphic are displayed first; the remaining 5 transitions display each bulleted line of text.*

Sleep Debt Recovery



- Sleep debt can have serious consequences both on and off the job.
- A person can recover by:
  - Trying to repay hour for hour on your days off
    - Recovery sleep is deeper and restorative
- You have recovered from your sleep debt when you wake up naturally and feel refreshed
- At least 2 nights of uninterrupted sleep helps restore alertness
  - If you still feel fatigued, you will need more sleep

SLEEP DISORDERS AND SYMPTOMS

Sleep Disorders and Symptoms

Sleep Disorders and Symptoms

- **Sleep disorders result in sleep loss and interruption**
- **Sleepers often are unaware of the symptoms or impact, but may wake up un-refreshed and remain sleepy all day**

Sleep Disorder	Common Symptoms
Insomnia	• Difficulty falling or remaining asleep
Sleep Apnea	• Loud or disruptive snoring • Snoring accompanied by pauses in breathing
Restless Leg Syndrome	• Uncomfortable sensations in legs
Periodic Limb Movement Disorder	• Involuntary movement - twitching of arms or legs

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- Sleep disorders result in sleep loss and interruption
  - prevent a person from sleeping or sleeping soundly
- Sleepers often are unaware of the symptoms or impact, but may wake up un-refreshed and remain sleepy all day
  - the person becomes accustomed to feeling fatigued

Continued on next page

SLEEP DISORDERS AND SYMPTOMS *(Continued)*

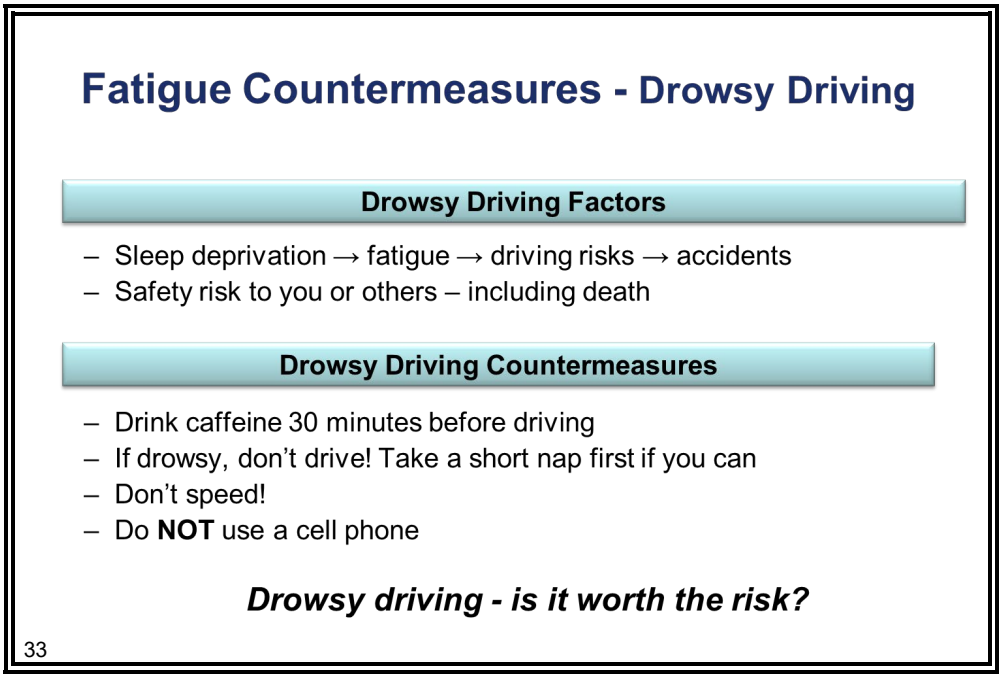
Sleep Disorders and Symptoms (Cont'd)

- ⊙ Sleep disorders:
  - Insomnia
    - One of the more common sleep problems characterized by difficulty falling or remaining asleep
    - Awaking un-refreshed or with a headache, persistent daytime sleepiness
    - More long-term insomnia is usually linked to an underlying medical condition and may improve with treatment for the original condition.
  - Sleep Apnea
    - Loud or disruptive snoring
    - A common disorder is snoring accompanied by periodic pauses in breathing through the night
      - → The airway closes down or is blocked during sleep which doesn't allow enough airflow.
      - → The brain then wakes the person, disrupting the sleep cycle, and preventing deep and restorative sleep.
      - → This may happen hundreds of times in one night
    - It is more common in men and those who are overweight.
  - Restless Leg Syndrome (RLS)
    - RLS produces an uncomfortable sensation in the legs that may begin in the evening or before falling asleep.
  - Periodic Limb Movement Disorder (PLMD)
    - PLMD involves involuntary, repetitive involuntary movement or twitching of arms and legs throughout the night.
- ⊙ Sleep disorders are often unnoticed by the sleeper, but others may notice. This is something to take seriously.
- ⊙ Consult your physician if you suspect you may have a sleep disorder.

FATIGUE COUNTERMEASURES – DROWSY DRIVING

☞ ***NOTE:*** *PowerPoint presentation: There are 4 transitions in this presentation. The graphic title is displayed first; click, the first title bar and 2 bulleted text displays; click, the second title bar and 3 bulleted text display; the last line of text is displayed.*

Fatigue Countermeasures – Drowsy Driving



Drowsy Driving

- Drowsy Driving Factors
  - Sleep deprivation leads to fatigue, which leads to driving risks which leads to accidents
    - It is a safety risk to you or others, both on and off the job. Could also lead to death.
- Drowsy Driving Countermeasures
  - Drink caffeine 30 minutes before driving
  - If drowsy, do not drive, take a short nap first if you can
  - Do not speed.
  - Do **NOT** use a cell phone.

INSTRUCTOR-LED DISCUSSION

Discussion

QUESTION: You are commuting home after the midnight shift. You have been working all night, it is rush hour and kids are playing around at the bus stop.

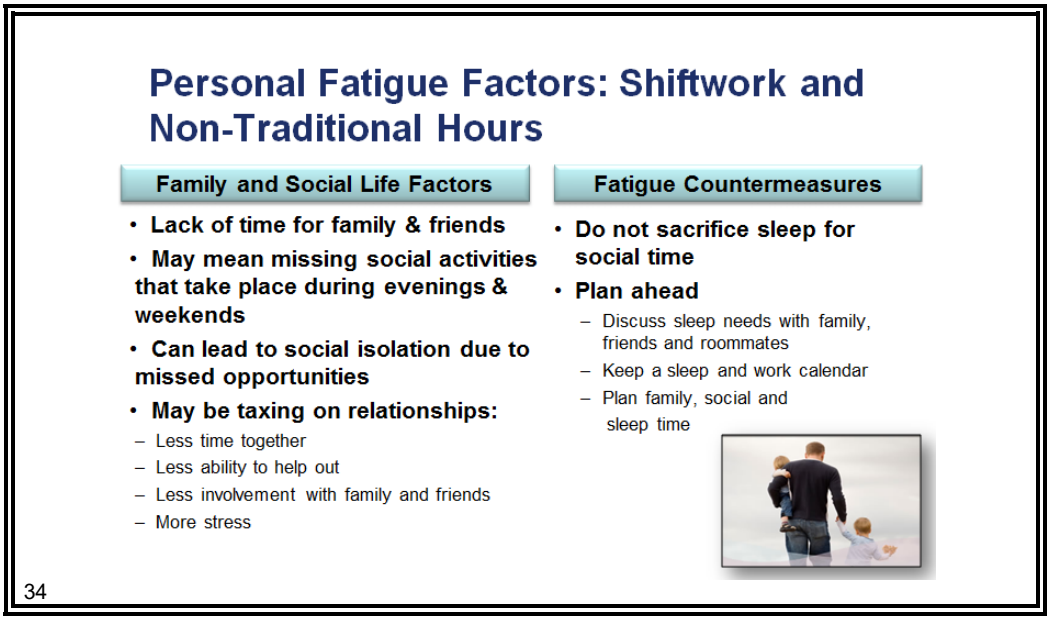
How would not getting enough sleep impair your judgment, performance, and reactions times?

☞ ***NOTE:*** *Discuss with the student's their responses.*

PERSONAL FATIGUE FACTORS

☞ ***NOTE:*** *PowerPoint presentation: There are 5 transitions in this presentation. The graphic title and the subject title bars are displayed first; click, the first column of text displays: click, the text fades; click, the second column of text displays; click the text fades.*

Personal Fatigue Factors: Shift-work and Non-Traditional Hours



Shiftwork and Non-Traditional Hours

⊙ Family and Social Life Factors

- Lack of time for family and friends
- May mean missing social activities that take place during evenings and weekends
- Can lead to social isolation due to missed opportunities
- May be taxing on relationships
  - Less time together
  - Less ability to help out
  - Less involvement with family and friends
  - More stress

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PERSONAL FATIGUE FACTORS *(Continued)*

☞ ***NOTE:*** *This section is VERY important for the students to understand and to think about. The decisions they make here can have significant long-term impact on their lives.*

Shiftwork and Non-Traditional Hours (Cont'd)

- ⊙ Fatigue Countermeasures
  - Do not sacrifice sleep for social time
  - Plan ahead
    - – Discuss sleep needs with family, friends and roommates
    - – Keep a sleep and work calendar
    - – Plan family, social and sleep time
- ⊙ The number one complaint of shift-workers and those subject to callback is a lack of time for family and friends

INSTRUCTOR-LED DISCUSSION

Discussion

⊙ Let's imagine, you are scheduled to work straight midnight shifts for th3 next four months, your days off are Wednesday and Thursdays.

QUESTION: What would be your biggest obstacle, today, that would make it difficult for you to balance your work schedule, get the recommended amount of sleep, and have time to spend with your family and /or friends?

☞ ***NOTE:*** *Discuss with the student's their responses.*

PERSONAL FATIGUE FACTOR: EXERCISE

☞ ***NOTE:*** *PowerPoint presentation: There are 3 transitions in this presentation. The slide title, the subject title bars and graphics are displayed first; click, the first column of text displays; click, the second column of text displays.*

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Exercise Factors

- Exercise Factors
  - Without exercise, you miss the benefits of:
    - Improving your physical and mental health
    - Improving your sleep quality
- Exercise leads to improved sleep if done strategically
- Do not sacrifice sleep in order to exercise. Both are needed.
  - The effect of exercise will be negated by the lack of sleep and you will be unlikely to see positive outcomes

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PERSONAL FATIGUE FACTOR: EXERCISE *(Continued)*

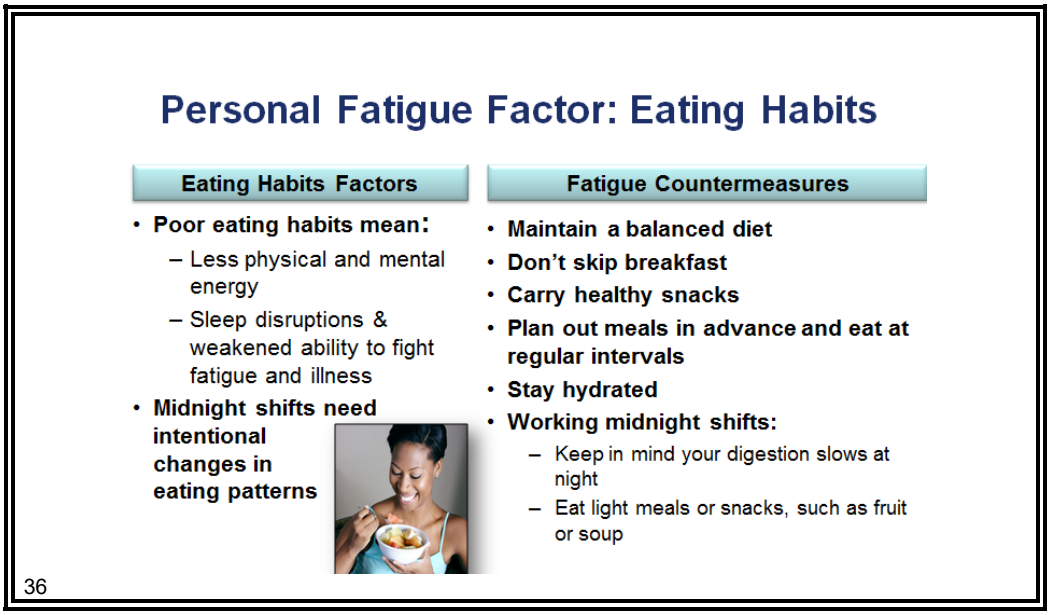
Exercise Factors (Cont'd)

- Fatigue Countermeasures
  - It is important to get regular exercise
    - Elevate your heart rate by exercising at least 20 – 30 minutes 3 – 4 times per week
    - You might take a brisk walk; go jogging or biking; or even quick repetitions of resistance or weight training moves.
    - The idea is that you can strengthen your heart by asking it to work a little harder than normal.
  - Avoid exercise within 2 hours of bedtime
    - Exercise elevates your heart rate and temperature which increases alertness and makes it difficult to sleep.
    - It takes your body time to wind back down, and in turn, to get to sleep
- Exercise has a long list of health benefits
  - It improves cardiovascular health by:
    - reducing the risk of heart disease
    - lowering blood pressure
    - lowering cholesterol
  - Strengthens immune functioning
  - Improves muscle tone and strength
  - Improves energy levels and stamina which guard against fatigue
  - Beneficial for mental health because it causes the body to release endorphins
    - Improves mood
    - Relieves stress
    - Can even help those suffering from depression
  - Leads to improved sleep
    - it is easier to get to sleep and experience longer lasting and more restful sleep

PERSONAL FATIGUE FACTOR: EATING HABITS

☞ ***NOTE:*** *PowerPoint presentation: There are 6 transitions in this presentation. The slide title, the subject title bars and graphics are displayed first; click, the first line of text in left column is displayed; click, the second line of text is displayed; click, the next 2 lines of text is displayed; click, left column fades; click the right column of lined text is displayed.*

Personal Fatigue Factor: Eating Habits



Eating Habits

- Healthy eating habits do not necessarily increase alertness or promote sleep dramatically, but it is essential for *managing* fatigue.
- Water is like food for your body---it is one of the very best ways to fight fatigue.
- Eating Habits Factors:
  - Poor eating habits lead to:
    - Less physical and mental energy
    - Sleep disruptions and weakened ability to fight fatigue and illness
- Midnight shifts need intentional changes in eating patterns

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PERSONAL FATIGUE FACTOR: EATING HABITS
(Continued)

Eating Habits (Cont'd)

⊙ Fatigue Countermeasures

- It is very important to maintain a healthy balanced diet, including one this is high in protein and relatively low in fat and carbohydrates.
  - Meals that provide protein and carbohydrates pack a great one-two punch.
  - They provide a quick energy boost as well as the fuel necessary for more sustained alertness.
- Do not skip breakfast
  - Eating breakfast daily can help provide the energy to start each day out right.
  - Supplying your body with fuel soon after you get up can help to prevent fatigue throughout your day.
- Carry healthy snacks with you so that you have an available "pick-me-up" if you should start to feel tired or hungry between meals
- Plan out meals in advance and eat at regular intervals
  - This ensures you are prepared and makes it less likely that you will need to grab quick and likely unhealthy, alternatives.
  - Keeping your blood sugar level up can help to fight off fatigue and consistently supply your body energy
- Stay hydrated
  - Be sure to drink plenty of fluids and stay well hydrated. Remember, caffeinated beverages can actually contribute to dehydration.
  - Water is one of the very best ways to fight fatigue.
- Working midnight shifts
  - Keep in mind your digestions slows at night
  - Eat light meals or snacks, such as fruit or soup

INSTRUCTOR-LED DISCUSSION

Discussion

⊙ During the previous discussion we talked about obstacles you have right now if you were working straight midnight shifts?

QUESTION: Based on what you were just taught, what would you do to make getting enough sleep a priority?

☞ ***NOTE:*** *Discuss with the student's their responses.*

PERSONAL FATIGUE FACTOR: HEALTHY SLEEP HABITS

☞ ***NOTE:*** *PowerPoint presentation: There are 11 transitions in this presentation. The slide title and graphic are displayed first; the remaining 10 transitions, click, each bulleted test will display.*

Personal Fatigue Factor: Healthy Sleep Habits

Healthy Sleep Habits

- The more you can develop healthy sleep habits now, the better and safer they will be on and off the job.

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PERSONAL FATIGUE FACTOR: HEALTHY SLEEP HABITS *(Continued)*

Healthy Sleep Habits (Cont'd)

⊙ Background on healthy sleep habits:

- Schedule your sleep into your daily activities.
  - Make sleep a priority.
    - → Neglecting your sleep is much more likely to have negative consequences than neglecting the yard work or the dishes.
  - Be sure to keep your sleep schedule regular as much as possible.
    - → This means getting up and going to bed at the same time each day, even on your days off.
    - → This helps to adapt your body to the schedule so that you don't have to fight so hard to get up or to stay awake.
- Create a bedtime routine and stick to it.
  - Establishing a regular bedtime routine can help you to prepare your mind and body for sleep.
    - → As you develop a pattern of behavior, your body will start to anticipate what comes next and will begin to wind itself down to prepare for sleep.
- Create a comfortable sleep environment.
- If you cannot sleep, get out of bed briefly.

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PERSONAL FATIGUE FACTOR: HEALTHY SLEEP HABITS *(Continued)*

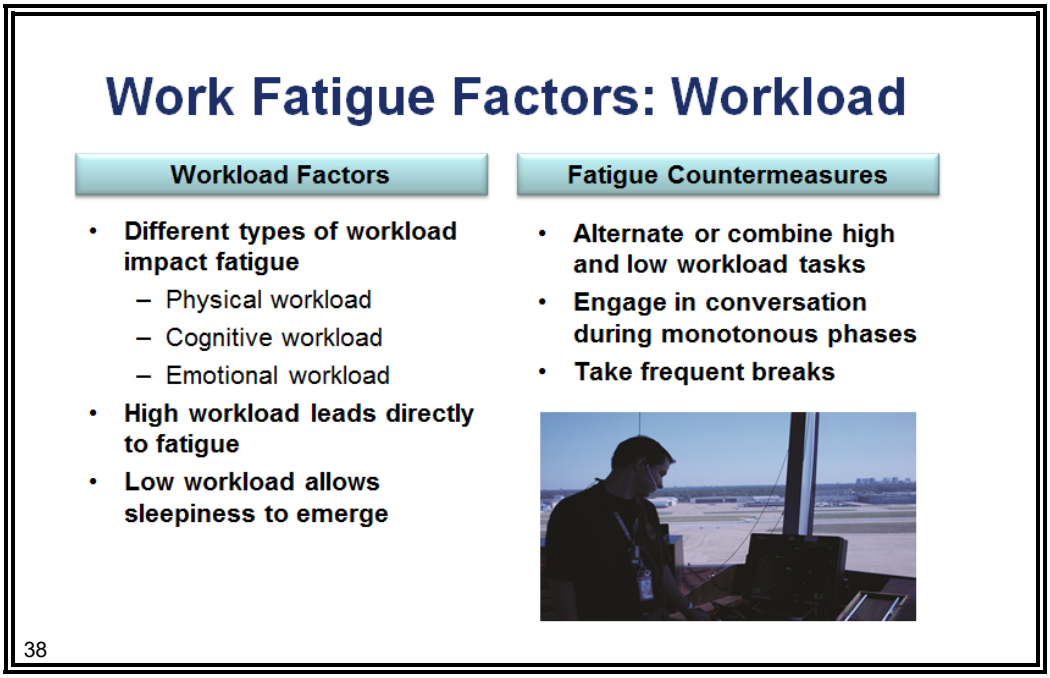
Healthy Sleep Habits (Cont'd)

- Relax before bed.
  - Reading is usually a good choice.
  - You can also try a quiet, relaxing activity.
  - Try a hot bath 1 or 2 hours before bedtime.
    - → However a raised body temperature can interfere with sleep.
  - Get a massage, try stretching, yoga, or meditation.
  - Incorporate mental or physical relaxation techniques into your bedtime routine.
    - → This can help you to unwind and relieve stress.
  - Journaling is also an option. Some people find that it helps to relieve the stress from the day.
  - Writing a "to do" list for the next day can also help you to feel more prepared for the day ahead.
    - → Be sure you don't perform these activities in bed; rather, sit in a chair or comfortable place where you can relax
- Keep the room dark and cool.
- Turn the face of your alarm clock away from you.
- Do not watch television or use a laptop in bed.
  - Watching television tends to be stimulating and can actually make it more difficult to get to sleep.
    - → If you do watch television, stick to the sit-coms or documentaries. Be sure to avoid anything too exciting or scary.
- Reduce noise.
  - Try earplugs or a white noise machine.
- Block light with an eye mask or room darkening curtains.

WORK FATIGUE FACTORS: WORKLOAD

☞ ***NOTE:*** *PowerPoint presentation: There are 3 transitions in this presentation. The slide title, the subject title bars and graphics are displayed first; click, the left column of text is displayed; click, the right column of text is displayed.*

Work Fatigue Factors: Workload



Workload Factors

⊙ Workload factors:

- Different types of workload impact fatigue
  - – Physical
    - → Activities that are involved in work, such as lifting or pushing something
  - – Cognitive
    - → Mental activity that is required to perform the job. This might include a planning task or an operation that simply requires monitoring.
  - – Emotional
    - → The effort it takes to work with people, both co-workers and customers. For instance, if you have to deal with a customer complaint or with a difficult co-worker or boss.

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WORK FATIGUE FACTORS: WORKLOAD *(Continued)*

Workload Factors (Cont'd)

- High workload leads directly to fatigue
  - It is physically, mentally, or emotionally taxing.
  - High workload essentially depletes your available resources.
  - You become fatigued, and you are unable to perform as well as you should.
  - This can be dangerous if the job requires quick actions or fast decision making.
- Low workload allows sleepiness to emerge
  - A lack of stimulation makes it possible for sleepiness and fatigue to emerge.
  - You may not realize that fatigue has set in.
  - Low workload can be dangerous in a monitoring task where you merely watch and make sure nothing goes wrong.
    - → What often happens is that fatigue sets in and makes you less effective if something happens that requires you to respond.

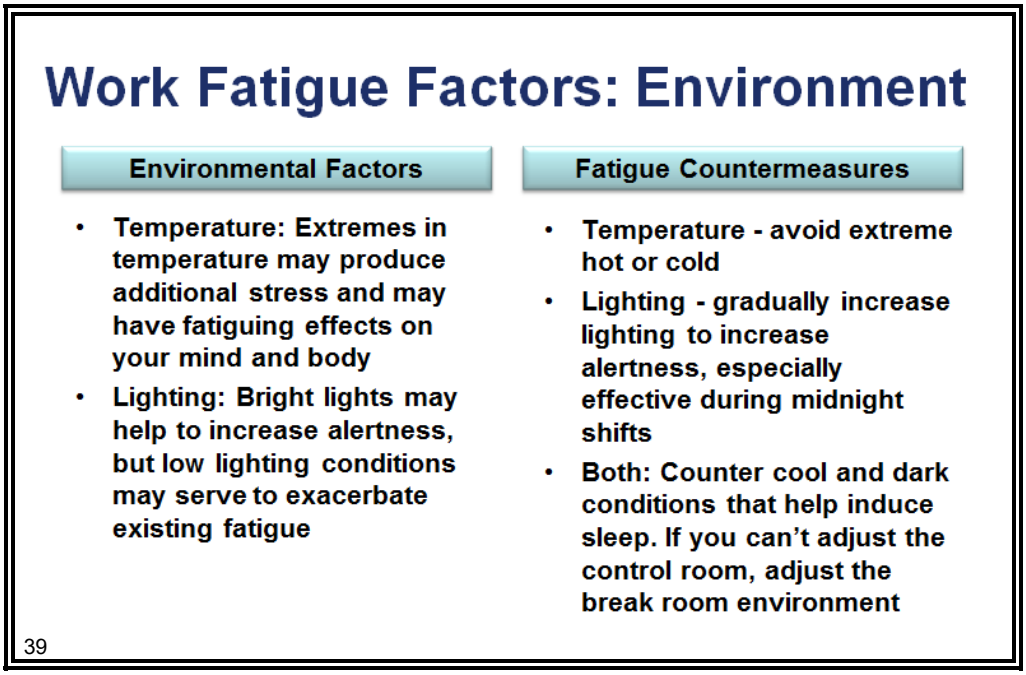
⊙ Fatigue Countermeasures

- Alternate or combine high and low workload tasks.
- Engage in conversation during monotonous phases.
- Take frequent breaks.

WORK FATIGUE FACTORS: ENVIRONMENT

☞ ***NOTE:*** *PowerPoint presentation: There are 6 transitions in this presentation. The slide title, the subject title bars are displayed first; click the remaining 6 transitions displays each bulleted text.*

Work Fatigue Factors: Environment



Environmental Factors

⊙ In some control environments temperature and lighting cannot be adjusted.

- In that case, controllers may be able to adjust the environment in the break room to help alertness before returning to control duties.

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WORK FATIGUE FACTORS: ENVIRONMENT *(Continued)*

Environmental Factors (Cont'd)

⊙ Environmental Factors

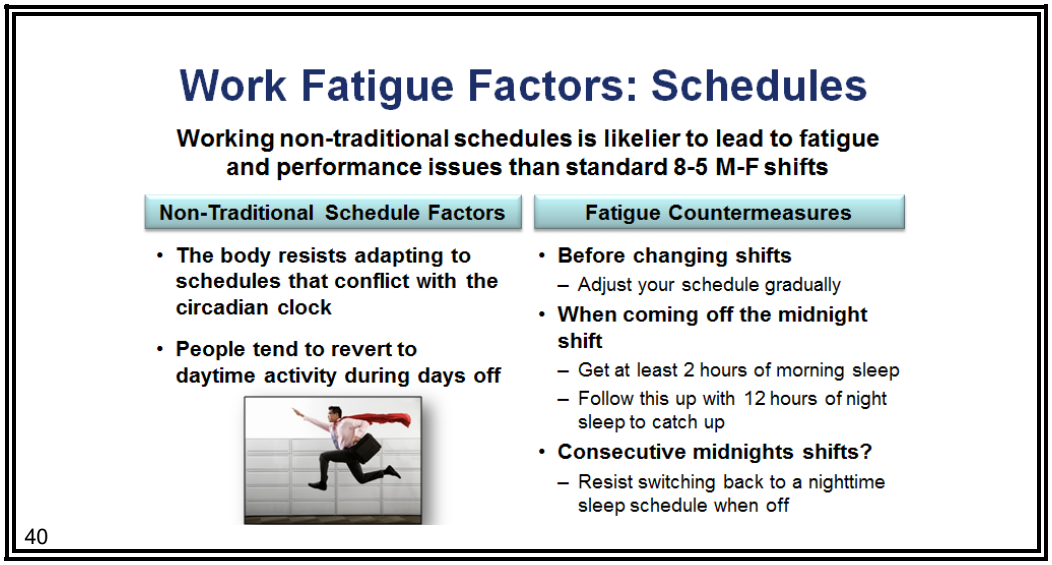
- Temperature: temperature extremes may produce additional stress and may have fatiguing effects on your mind and body
  - Individuals working in extreme temperature conditions, either hot or cold, must be aware that temperature can have fatiguing effects on your mind and body.
    - → Think of simple practical ways to reduce fatigue caused by temperature extremes. For example, if the control room is unusually cold, keep a sweater on hand during your shift.
- Lighting: Bright lights may help to increase alertness, but low lighting conditions may serve to exacerbate existing fatigue.
  - Additionally, during midnight shifts, when your body's natural rhythm is at its lowest point, poor lighting conditions will likely contribute to feelings of fatigue and sleepiness.

⊙ Fatigue Countermeasures

- Temperature
  - avoid extreme hot and cold
- Lighting
  - gradually increase lighting to increase alertness, especially effective during midnight shifts
- Both
  - counter cool and dark conditions that help induce sleep
  - if you cannot adjust the control room, adjust the break room environment

WORK FATIGUE FACTORS: SCHEDULES

☞ ***NOTE:*** *PowerPoint presentation: There are 6 transitions in this presentation. The slide title, the subject title bars and graphic are displayed first; click, the bulleted text in the left column is displayed; click, the first group of bulleted text in the right column is displayed; click, the second group is displayed; click, the last group is displayed.*



Schedule Factors

⊙ Working non-traditional schedules is a key secondary fatigue contributory factor.

- It is likelier to lead to fatigue and performance issues than working the standard eight to five, Monday thru Friday shifts

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WORK FATIGUE FACTORS: SCHEDULES *(Continued)*

Schedule Factors (Cont'd)

⊙ Non-traditional schedule factors

- The body resists adapting to schedules that conflict with the circadian clock.
  - Non-traditional schedules may include rotating shifts, evenings, midnight shifts (overnight), scheduled overtime, etc.
    - → Shiftwork is inherent in most aviation positions.
  - While alternative schedules often come with benefits to employers in the form of longer hours of production and to employees in the form of larger blocks of time off and increased wages, they can also lead to increased fatigue and associated safety and performance issues *(Moore-Ede, 2006)*.
  - When you work alternative schedules:
    - → You are more likely to suffer from insomnia and excessive daytime sleepiness.
    - → You may have a difficult time changing your waking and sleeping schedule to match your work schedule because it requires working against your natural body clock.
  - Your circadian rhythm relies on natural light and dark cues, making it difficult to adapt it to a schedule that does not coincide.
- People tend to revert to daytime activity during their days off
  - If kept on a regular schedule, the human body can adapt to some extent, however, people often go back to a "normal" schedule on their days off making it difficult for their body clock to fight the circadian rhythm and adapt to a different schedule.
  - Research shows that people who sleep during the day are estimated to get 1.5 to 2 hours less sleep *each night* compared to night sleepers *(Shapiro, Heslegrave, Beyers, & Picard, 1997)(Akerstedt, Knutsson, Westerholm, Theorell, Alfredsson, & Kecklund, 2004; Costa, 1997; Dahlgren, 2006)*

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WORK FATIGUE FACTORS: SCHEDULES *(Continued)*

Schedule Factors (Cont'd)

- Fatigue Countermeasures
  - Before changing shifts
    - adjust your schedule gradually
  - When coming off the midnight shift:
    - get a least 2 hours of morning sleep
    - follow up with 12 hours of night sleep to catch up
  - Consecutive midnight shifts
    - resist switching back to a nighttime sleep schedule when off

INSTRUCTOR-LED DISCUSSION

Discussion

⊙ We just discussed traditional schedules, the fatigue factors and countermeasures.

QUESTION: Are you aware of the type of schedule or shift rotation at your facility?

QUESTION: How will schedule or shift rotation conflict with your current lifestyle?

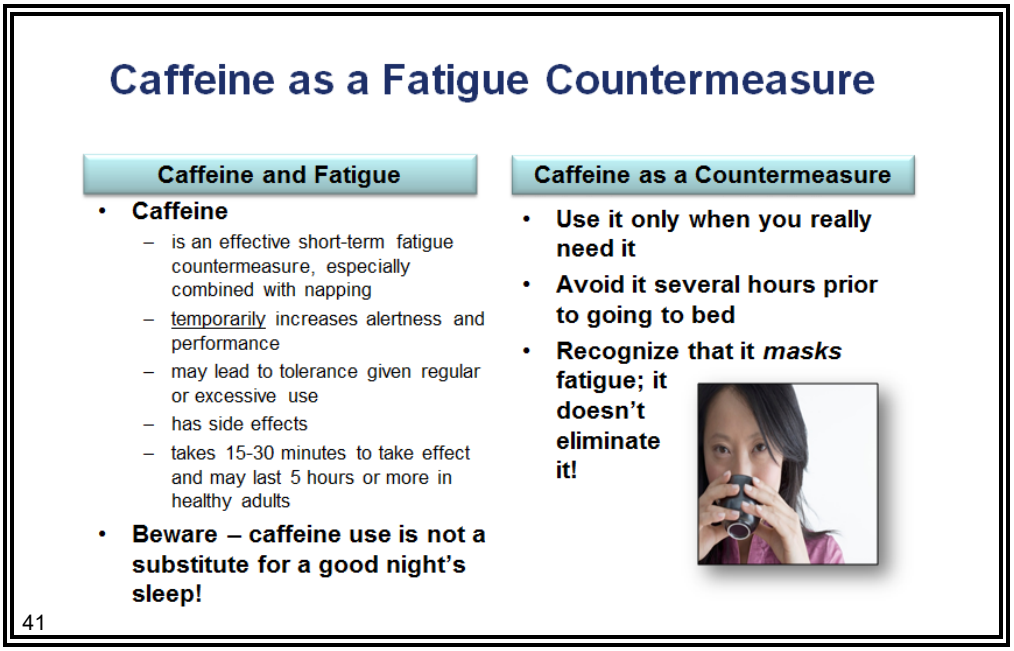
⊙ Aviation safety is in your hands. Working fatigued due to sleep loss is risky.

☞ ***NOTE:*** *Discuss with the student's their responses. Use examples of non-traditional schedules from your experience.*

CAFFEINE AS A FATIGUE COUNTERMEASURE

☞ ***NOTE:*** *PowerPoint presentation: There are 6 transitions in this presentation. The slide title, the subject title bars and graphic are displayed first; click, the first group bulleted text in the left column is displayed; click, the last bulleted text is displayed; click, the first bulleted text in the right column is displayed; click, the second bulleted text is displayed; click, the last bulleted text is displayed.*

Caffeine as a Fatigue Countermeasure



Caffeine and Fatigue

⊙ Caffeine and fatigue

- Caffeine:
  - – can be an effective short-term countermeasure, especially combined with napping, but it is not a substitute for a good night's sleep
    - → In fact, caffeine masks fatigue. Just use it strategically.
  - – is a popular stimulant that is often used to increase alertness or performance
  - – may lead to tolerance given regular or excessive use
  - – has side effects

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CAFFEINE AS A FATIGUE COUNTERMEASURE
(Continued)

Caffeine and Fatigue (Cont'd)

- Caffeine ***(cont'd)***
  - takes 15-30 minutes for the stimulating effects of caffeine to be felt and may last 5 hours or more in healthy adults
    - → However, if you are especially sensitive to caffeine you may feel the effects for up to 10 hours *(Bolton, 1981; Meyer et al., 1991; Ortweiler et al., 1985; Springhouse, 2005).*
  - It's found most commonly in coffee, tea, soft drinks, and chocolate, but is also found in "alertness aids" such as No Doz or Vivarian and over-the-counter cold medications such as pain relievers, appetite suppressants, and cold medications.
- Beware, caffeine use is not a substitute for a good night's sleep.

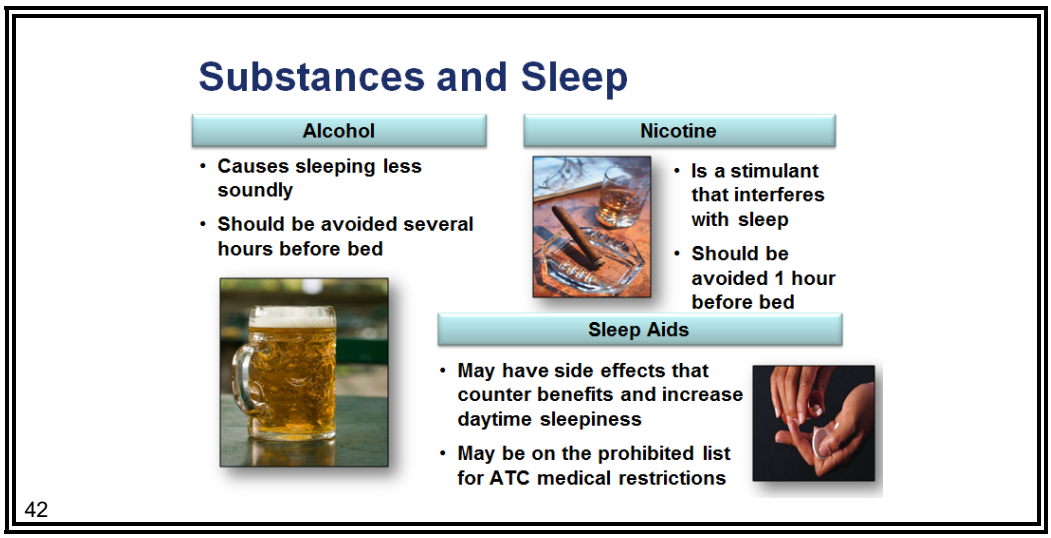
⊙ Caffeine as a countermeasure can be a very useful if used appropriately and is safe if used in moderation.

- Use it only when you really need it.
  - Excessive caffeine use can also be bad for your health.
    - → It can result in side effects such as elevated blood pressure or stomach problems and frequent users can experience withdrawal symptoms such as headaches, irritability, or nervousness.
- Avoid it several hours prior to going to bed.
- Recognize that it masks fatigue, it does not eliminate it.
  - With regular or extended use of caffeine, you can actually develop a tolerance which means that you will need to consume more to get the same effect.

SUBSTANCES AND SLEEP

☞ ***NOTE:*** *PowerPoint presentation: There are 5 transitions in this presentation. The slide title, the subject title bars and graphics are displayed first; click the remaining 5 transitions displays each bulleted text.*

Substances and Sleep



- Remembering that time awake, time asleep and circadian clock disruption are primary causes of fatigue.
- Substances may interfere with quality and quantity of sleep.
  - As a controller, you must adhere to restrictions about certain medications as well as blood alcohol concentration.

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SUBSTANCES AND SLEEP *(Continued)*

Substances and Sleep (Cont'd)

⊙ Alcohol:

- Should be avoided several hours before bed
  - Although many can attest to the fact that alcohol increases sleepiness, it should really be avoided before going to bed because it interferes with the sleep cycle.
- Causes sleeping less soundly
  - This means that even though it may take less time to fall asleep, people tend to sleep less soundly and are more likely to wake up midway through the night.
    - → For example, alcohol tends to result in an increased number of trips to the bathroom which also disrupts sleep.
    - → It takes roughly one hour to metabolize one regular drink or beer and the quality of sleep will be best if all alcohol in the system is metabolized prior to sleep onset.

⊙ Nicotine:

- Nicotine, found in cigarettes, cigars, and other tobacco products, is a stimulant that can interfere with sleep.
- Should be avoided one hour before bed.
- Most noticeably it may interfere with the ability to get to sleep, but it can also interfere with the ability to remain asleep if a person experiences nicotine withdrawal.
- Research shows that after only 10 days of quitting nicotine sleep is dramatically improved.

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SUBSTANCES AND SLEEP *(Continued)*

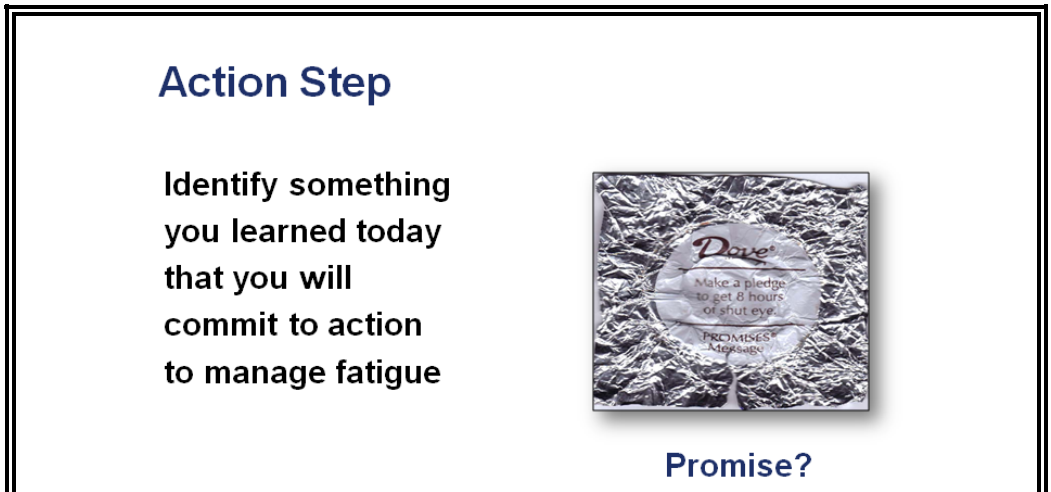
Substances and Sleep (Cont'd)

⊙ Sleep Aids:

- May have side effects that counter benefits and increase daytime sleepiness
  - Sleep aids, when used, should promote sleep and thereby increase daytime alertness.
- In general, both prescription and over-the-counter sleep aids can be very effective and very useful when used responsibly.
  - However, caution should be exercised because sleep aids have the potential to increase daytime drowsiness or create additional sleep disturbances.
  - They can also result in dependency, overdose or misuse, and have the potential to produce withdrawal symptoms and daytime drowsiness.
- It is important to use sleep aids cautiously and only after trying other countermeasures discussed in this training.
- Some sleep aids may be on the prohibited list for ATC medical restrictions.
  - So before using prescription sleep aids such as Ambien or Restoril, be sure to consult a doctor about your specific situation.
    - → Prescription sleep aids can be very effective for getting better rest, but they do come with a risk of some pretty serious side effects, including extended periods of drowsiness, dizziness, confusion, forgetfulness, poor motor function, delusions, amnesia, dependence, overdose, sleep disturbance, and withdrawal symptoms.
  - Make sure you talk to your doctor about all of the options and about your particular schedule.
- Over-the-counter sleep aids such as diphenhydromine, found in Sominex, Tylenol PM, and Benadryl, are available without a doctor's prescription.
  - Similar to prescription drugs, these medications may still have side effects such as drowsiness and performance degradation.
  - Additionally, because these drugs are unregulated, the long-term effects of regular use has not been as well documented

ACTION STEP

Action Step



- Identify something you learned today that you will commit to action to manage fatigue.

CONCLUSION

Lesson Summary

⊙ This lesson covered:

- Fatigue Awareness and Countermeasures
  - Fatigue Basics
  - Sign and Symptoms of Fatigue
  - Fatigue in Operational Environment
  - Contributors to Fatigue
  - Fatigue Components
  - Fatigue Safety Hazards
  - NTSB ATC Fatigue Concerns
  - Impact of Fatigue
  - The Circadian Clock
  - Circadian Rhythm Drives Alertness
  - The Circadian Clock and Sleep Loss
  - Sleep Basics
  - Consolidated Sleep Period Benefits
  - Importance of the Sleep Process
  - Sleep Inertia
  - Calculate Your Sleep Debt
  - Sleep Debt Impacts Performance
  - Sleep Debt Recovery
  - Sleep Disorders and Symptoms
  - Drowsy Driving
  - Personal Fatigue Factors
  - Work Fatigue Factors
  - Caffeine as a Fatigue Countermeasure
  - Substances and Sleep

☞ ***NOTE:*** *Ask students if there are any questions.*

ADDITIONAL RESOURCES

Available Resources

- Available Resources:
  - Call the ATO, Office of Safety and Technical Training, Fatigue Risk Management Team
  - **EUROCONTROL:**
    - *http://www.skybrary.aero/landingpage/*
    - *http://www.skybrary.aero/index.php/Fatigue*
  - **CDC:**
    - *http://www.cdc.gov/sleep/*
    - *http://www.cdc.gov/Features/dsSleep/*
    - *http://www.cdc.gov/sleep/publications/published_papers.htm*
  - ***HHS:***
    - *http://www.nhlbi.nih.gov/health/public/sleep/healthy_sleep.pdf*
    - *http://www.nhlbi.nih.gov/health/public/sleep/healthy_sleep_atglance.htm*
  - ***MIT:***
    - *http://medweb.mit.edu/pdf/sleep_well.pdf*
  - **Boston Globe:**
    - *http://www.boston.com/bostonglobe/ideas/naps/*
  - **National Sleep Foundation***:*
    - *http://www.sleepfoundation.org/video/heads-the-wheel- drowsy-driving-prevention*
- Additional resources available:
  - Call the ATO, Offices of Safety and Technical Training or the Fatigue Management Team.
  - www.fullychargedapp.com
  - https://my.faa.gov/org/linebusiness/ato/safety/fully_charged.html