Sleep:
The Most Important Component of Safe Behavior
Americans and Sleep

40% of children
90% of teens
70% of young adults at college
35% of working adults

Percent of people who do not get the required amount of sleep every night.
How much sleep is enough?
Why Are We Not Getting Enough Sleep?

1. We don’t know the importance of sleep
2. We have economic and social pressures to stay awake
3. We simply have too much to do
4. We suffer from sleep disorders
5. We work shift work or more than 40 hours per week
Accidents and Sleep Deprivation

Fatigued workers are 70% more likely to be involved in accidents.

Union Carbide Gas Release
- Bhopal, India

Nuclear Power Plant Meltdown
- Chernobyl, Ukraine
- Three Mile Island, US

Grounding of the Exxon Valdez oil tanker
- Prince William Sound, AK

Explosion of the Challenger space shuttle
Are You Getting Enough Sleep?

Do you need coffee to get you running before noon?

If the alarm wouldn’t go off, would you sleep longer?

After getting up early, would you be able to go back to sleep before noon?
Symptoms of Sleep Deprivation

- Sleepiness
- Yawning
- Moodiness
- Fatigue
- Irritability
- Depressed mood
- Difficulty learning new concepts
- Forgetfulness
- Inability to concentrate or a "fuzzy" head
- Lack of motivation
- Clumsiness
- Increased appetite and carbohydrate cravings
Sleep

WHAT IS IT AND WHY DO WE NEED IT?
Sleep

One of the greatest mysteries of the human world.

What happens when we fall asleep?
- Loss of external awareness
- Sense of time distortion

What is sleep?
- A time when the body and brain “shut off”
- A time where the body and brain work harder than they do during the day
Types of Sleep

Non-rapid eye movement (NREM)
- Memory and learning consolidation
- Lowers heart rate, temperature, and breathing rate
- Repairs muscle tissue
- Releases hormones
- Boosts immune system

Rapid eye movement (REM)
- Brain is active
- Dreams
- Body is paralyzed
- Consolidation and creativity
Sleep Architecture

- **Fall Asleep**
  - Stage 1 (Lightest Sleep)
  - Stage 2
  - Stage 3 (Deepest Sleep)
  - Stage 4

- **One Sleep Cycle (~90min)**
  - Notice how the REM stage gets longer

- **REM = Rapid Eye Movement**
  - NREM = Non-REM

15-20 min

- **Areal of surroundings**
- **Brain waves start to slow down**
- **Slow moving delta brain waves**

20 min power naps

Wake up alert

Wake up groggy

REM = Rapid Eye Movement
NREM = Non-REM

Energy, Mining & Construction Industry Safety
Colorado School of Mines
What Controls Sleep?

Circadian Rhythm
Sleep Pressure

WAKEFULNESS
SLEEP PRESSURE

FALL ASLEEP
WAKE UP

AWAKE
SLEEP
AWAKE

6:00 AM 10:00 PM 6:00 AM
Circadian Rhythm

Provides instructions to the brain and body to initiate sleep.
Larks and Owls
Sleep Pressure

ATP
Adenosine Triphosphate

Energy

Adenosine
Adenosine

Sleep Neuron

Adenosine Activates

Awake Neuron

Adenosine Puts to Sleep
Wake-up Refreshed

BENEFITS OF SLEEP
## Benefits of Sleep

<table>
<thead>
<tr>
<th>PHYSICAL</th>
<th>PSYCHOLOGICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protects the heart</td>
<td>Spurs creativity</td>
</tr>
<tr>
<td>Keeps bones strong</td>
<td>Learn and memorize new information</td>
</tr>
<tr>
<td>Preserves skin health</td>
<td>Stabilizes emotions and mood</td>
</tr>
<tr>
<td>Cleans out the eyes</td>
<td></td>
</tr>
<tr>
<td>Maintains healthy weight</td>
<td></td>
</tr>
<tr>
<td>and metabolism</td>
<td></td>
</tr>
<tr>
<td>Regulates hormones*</td>
<td></td>
</tr>
<tr>
<td>Renews and repairs brain</td>
<td></td>
</tr>
<tr>
<td>cells*</td>
<td></td>
</tr>
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</table>

*Affects psychological wellbeing as well
Physical and Psychological Repair

- Melatonin Secretion Stops 7:30
- Lowest Body Temperature 4:30
- Deepest Sleep 2:00
- 9:00 Melatonin Secretion Starts
- 7:00 Highest Body Temperature
- 6:00 AM
- Noon 12:00
- 6:00 PM
- 6:30 Highest Blood Pressure
- 9:00 Melatonin Secretion Starts
- Rem
- NREM

Active

Psychological Repair

Physical Repair

Wind Down

Noon 12:00

6:00 AM

Lowest Body Temperature 4:30

Deepest Sleep 2:00

12:00 Midnight

6:00 PM
Physical and Psychological Repair

- Fall Asleep
- Stage 1 (Lightest Sleep)
- Stage 2
- Stage 3
- Stage 4 (Deepest Sleep)

Physical Repair
- REM
- NREM

Psychological Repair
- REM
- NREM

Wake

Hours

0 1 2 3 4 5 6 7 8
Dangers that Lurk

IMPACT OF SLEEP DEPRIVATION FOR WORKERS
Dangers of Sleep Deprivation

Impaired Information Processing
- Risky decisions

Diminished Performance
- Poor reaction time
- Reduced situational awareness
- Increased mental stalling
- Reduced work efficiency

Increased Micro-sleep Episodes
Increased Errors

Commission VS Omission
Misconceptions

I know when my performance is affected by sleep loss.
I have experience working on little sleep, and I can compensate.
As long as I am motivated and professional, I can overcome sleep deprivation.
I just don’t need much sleep.
I can catch up on sleep on the weekends.
Helpful Tips FOR A BETTER NIGHT’S SLEEP
Daytime Routine

Be early to rise
Increase sunlight exposure
Exercise wisely
Have a caffeine curfew
Time your evening meal
Have an alcohol curfew
What is Caffeine?

THE WORLD’S MOST POPULAR DRUG!
Foods That Contain Caffeine

Coffee

Tea
- Black
- Green
- White

Soft Drinks

Energy Drinks

Chocolate

Amount of caffeine per cup:
(or serving)

- Decaf coffee: 3 mg
- Hot chocolate: 19 mg
- Green tea: 20 mg
- Shot of espresso: 27 mg
- Can of cola: 40 mg
- Black tea: 45 mg
- Red Bull: 80 mg
- Instant coffee: 82 mg
- Brewed coffee: 95 mg
Caffeine’s Effect on Sleep

- Increased time to fall asleep
- Increased time awake
- Decreased REM and/or deep NREM sleep
- Decrease in overall sleep
After You Wake Up
Just Had Your Morning Coffee
Caffeine Concentration Peaks

- **Awake**
- **Sleepy**

**Time of Day**

**Wake up**

**Morning coffee**

**2 hrs later**
Caffeine Starts Decreasing
Feeling Sleepy Again
Steps to Reduce Caffeine Effects

Have a caffeine curfew

Consume less than 300mg/day
Daytime Routine

- Be early to rise
- Increase sunlight exposure
- Exercise wisely
- Have a caffeine curfew
- Time your evening meal
- Have an alcohol curfew
Alcohol’s Effect on Sleep

Alcohol decreases the time it takes to fall asleep.
Alcohol suppresses REM in the first part of the night.
Alcohol increases deep sleep early in the night.
Alcohol increases REM and time awake later at night.
## You Booze, You Lose

<table>
<thead>
<tr>
<th>Type of Alcoholic Beverage</th>
<th>Average Time to Metabolize</th>
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<tbody>
<tr>
<td>Small Shot of Liquor</td>
<td>1 hour</td>
</tr>
<tr>
<td>Pint of Beer</td>
<td>2 hours</td>
</tr>
<tr>
<td>Large Glass of Wine</td>
<td>3 hours</td>
</tr>
<tr>
<td>A Few Drinks</td>
<td>Several hours</td>
</tr>
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</table>
Steps to Reduce Alcohol Effects

- Have an alcohol curfew
- Eat food
  - May help your body absorb the alcohol
- Drink water
  - Won’t change the rate of metabolism
- Avoid caffeine
  - Will not alleviate intoxication quicker
Pre-Sleep Routine

- Avoid blue light
- Use supplementation wisely
- Calm inner-chatter
- Take a warm bath or shower
- Avoid spending time awake in bed
Sources of Blue Light

IT’S EVERYWHERE, AND UNAVOIDABLE

NATURAL LIGHT  ARTIFICIAL LIGHT  DIGITAL DEVICES
## Effects of Blue Light

<table>
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<th>BENEFICIAL</th>
<th>HARMFUL</th>
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<td>Helps regulate the circadian rhythm</td>
<td>Disruptions to the circadian rhythm</td>
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<tr>
<td>Boosts alertness</td>
<td>Digital eyestrain syndrome</td>
</tr>
<tr>
<td>Helps memory and cognitive function</td>
<td>Greater risk of cancer</td>
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<tr>
<td>Elevates moods</td>
<td>Greater risk of diabetes, heart disease and obesity</td>
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<tr>
<td></td>
<td>Increased risk of depression</td>
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<td></td>
<td>May cause permanent eye damage</td>
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Avoid Blue Light at Night

Blue light curfew
- At least 1 hour before bedtime (more is better)

Device Management
- F.lux
- Night Shift
- Twilight

Blue light blocking glasses
Pre-Sleep Routine

Avoid blue light

Use supplementation wisely

Calm inner-chatter

Take a warm bath or shower

Avoid spending time awake in bed
Magnesium

Why do you need it?
- Used by every cell and organ
- Easily depleted

Sleep impact
- Regulates melatonin

Deficiency
- Insomnia
- Poor sleep quality

How to get it?
- Foods
- Supplements
Well Intended Mistakes

Oral Melatonin

- Synthetic hormone
- Not regulated
- Does not make you sleep
- Produce enough naturally
- Jet lag

Sleep Aids

- Sedative hypnotic
- Does not induce natural sleep
- Reduced quality
- Unwanted side effects
Natural Alternatives

Kava Kava
Valerian root
Chamomile
Lavender
Pre-Sleep Routine

Avoid blue light
Use supplementation wisely
**Calm inner-chatter**
Take a warm bath or shower
Avoid spending time awake in bed
Helpful Tips Summary

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Create a Sleep Sanctuary

Get it blacked out

Be cool

Remove your “friends”

Use white noise
Looking for more?
Additional Resources

Stress, Fatigue & Your Brain

HTTPS://EMCIS.MINES.EDU/TRAINING/OTHER-COURSES/
Thank You!

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