

A stylized, colorful illustration of a landscape. In the foreground, there are rolling green hills with a dark brown path winding through them. To the left, there is a green tree and a purple flower. In the background, there are more green hills and a blue sky with white clouds. A small red bird is flying in the sky.

# #11 Circadian Rhythm & Shift work

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Carol H. Simpson © 1998

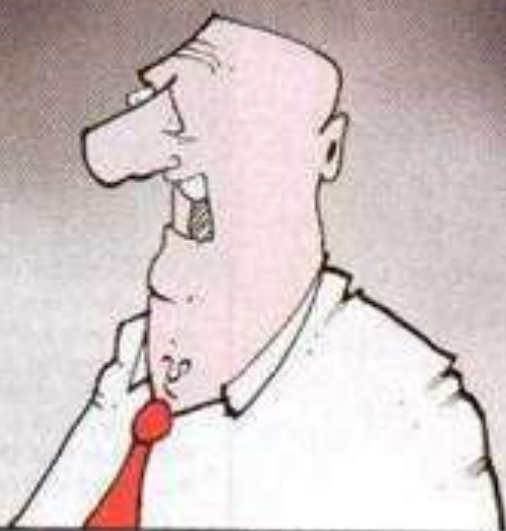




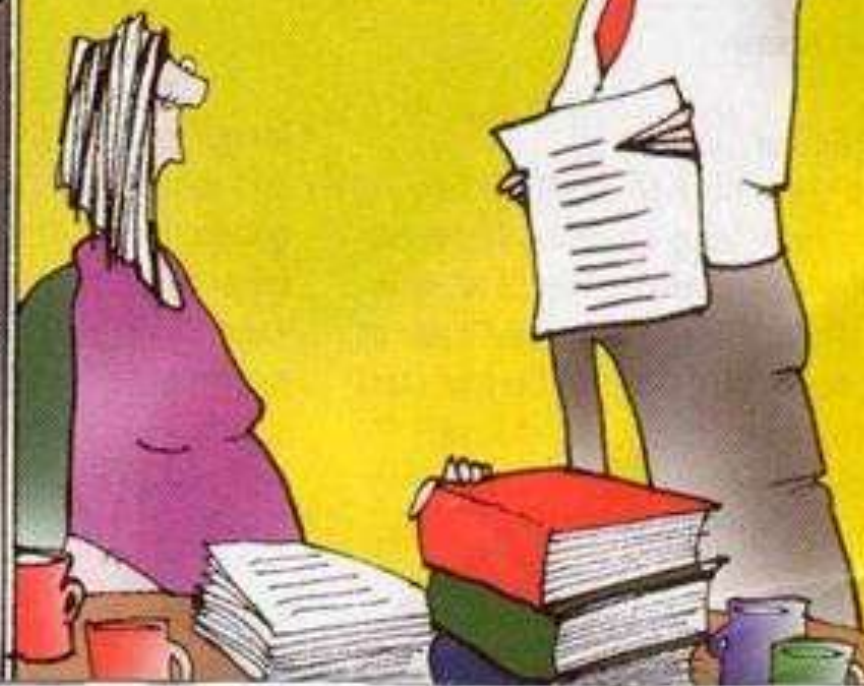
IT'S BEEN BROUGHT TO MY ATTENTION  
THAT YOU'VE BEEN DOING A LOT OF  
UNPAID OVERTIME...COMING IN EARLY  
GOING HOME HOURS AFTER EVERYONE  
ELSE HAS LEFT THE  
BUILDING!



I KNOW THAT YOU'RE  
AS CONCERNED ABOUT  
THE BUSINESS AS I AM  
...BUT AS YOUR MANAGER  
I CAN'T LET THIS CARRY  
ON WITHOUT TAKING  
SOME ACTION...



SO HERE'S A BILL FOR THE EXTRA  
UTILITIES YOU'VE BEEN USING,  
LIGHTING, HEATING... AND A  
NOMINAL CHARGE FOR  
USE OF THE TOILET  
FACILITIES.







**I has to work overtime again today**

**Do not want!**

Have you ever pulled an “all-nighter”?

**How did you feel afterwards?**



Flown the “red-eye” flight?

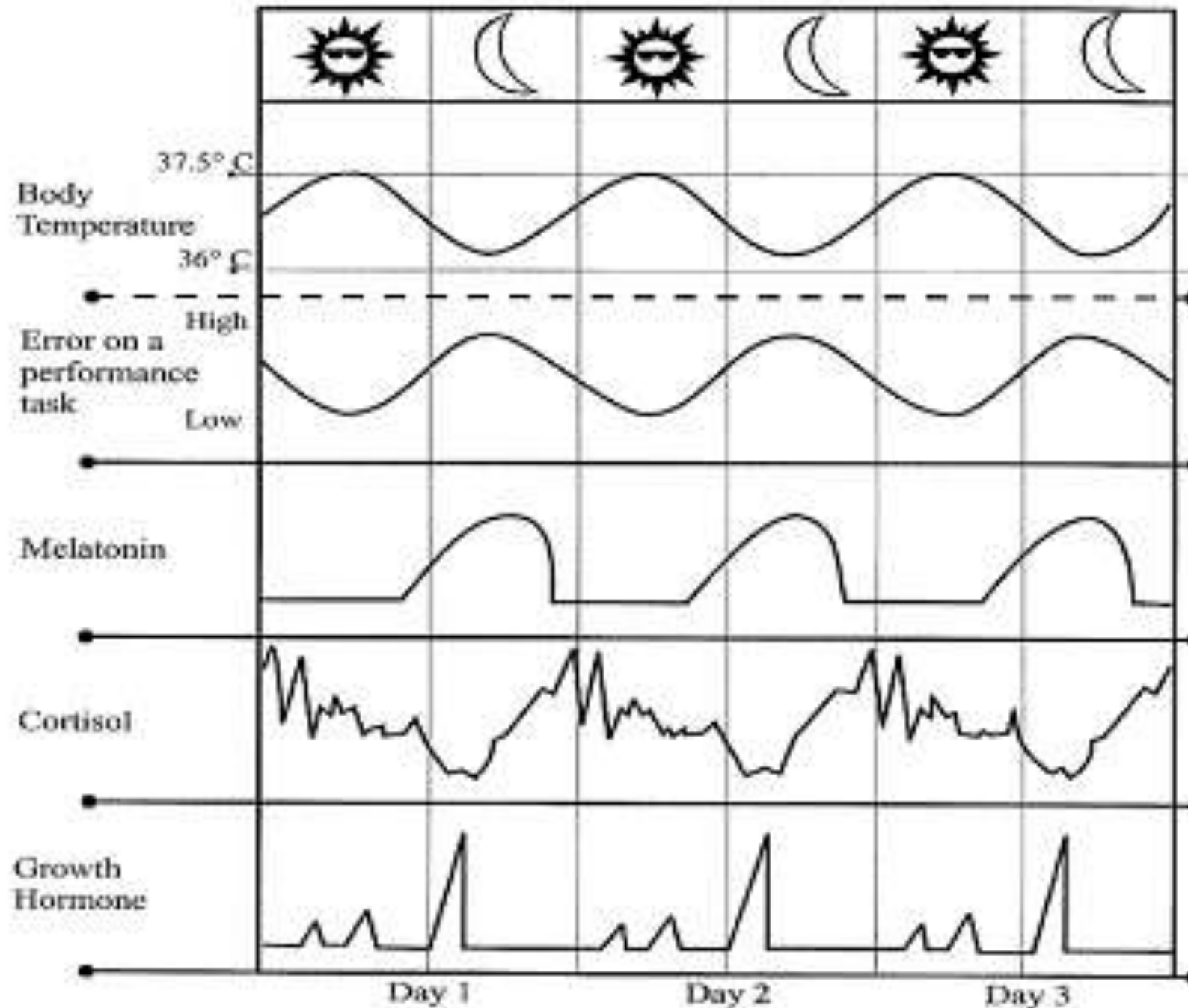


# CIRCADIAN RHYTHM



# Circadian Rhythms

- Definition → Natural physiological cycle the body goes through every day
- Function best during the daylight hours (4am–6pm), sleep best at night (6pm–4am).
- Cycle correlates with :
  - sleepiness
  - sleep efficiency (how long we sleep)
  - performance
  - errors and accidents
- **There is a built in body clock which controls** body temperature, alertness, muscle strength, digestion, hormone secretion, blood pressure, immediate & long term memory, kidney function etc.



A stylized landscape illustration featuring rolling green hills in the foreground, a small tree with a brown trunk and purple and pink foliage on the left, and light blue and white wavy hills in the background under a blue sky.

# SLEEP LOSS

# Cause Effects of Sleep Loss

## Causes of Sleep Loss

- deliberately staying awake
- sleeping at unnatural times
  - during daylight
  - counter to one's circadian rhythms
- sleeping with the effects of caffeine or alcohol

## Effects of Sleep Disruption

- impaired judgement
- reduced ability to learn
- reduced ability to store new material
- inability to plan



# The Epworth Sleepiness Scale

- A standardized scale used by sleep experts
- Assess your chance of dozing
  - 0 would never dose
  - 1 slight chance of dozing
  - 2 moderate chance of dozing
  - 3 high chance of dozing
- Scale : National Sleep Foundation

## The Epworth Sleepiness Scale (ESS)

How likely are you to doze off or fall asleep in the following situations, in contrast to feeling just tired? This refers to your usual way of life in recent times. Even if you have not done some of these things recently try to work out how they would have affected you. Use the following scale to choose the **most appropriate number** for each situation:

- 0 = would **never** doze
- 1 = **slight chance** of dozing
- 2 = **moderate chance** of dozing
- 3 = **high chance** of dozing

SITUATION	CHANCE OF DOZING (0-3)
Sitting and reading	
Watching television	
Sitting inactive in a public place (e.g. a theater or meeting)	
As a passenger in a car for an hour without a break	
Lying down to rest in the afternoon when circumstances permit	
Sitting and talking to someone	
Sitting quietly after a lunch without alcohol	
In a car, while stopped for a few minutes in the traffic	
TOTAL SCORE	

### SCORE RESULTS:

- 1-6 Congratulations, you are getting enough sleep!
- 7-8 Your score is average
- 9 and up Very sleepy and should seek medical advice

Johns, M.W. (1991). A new method for measuring daytime sleepiness: The Epworth sleepiness scale. *Sleep*, 14, 540-545.  
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# Solutions

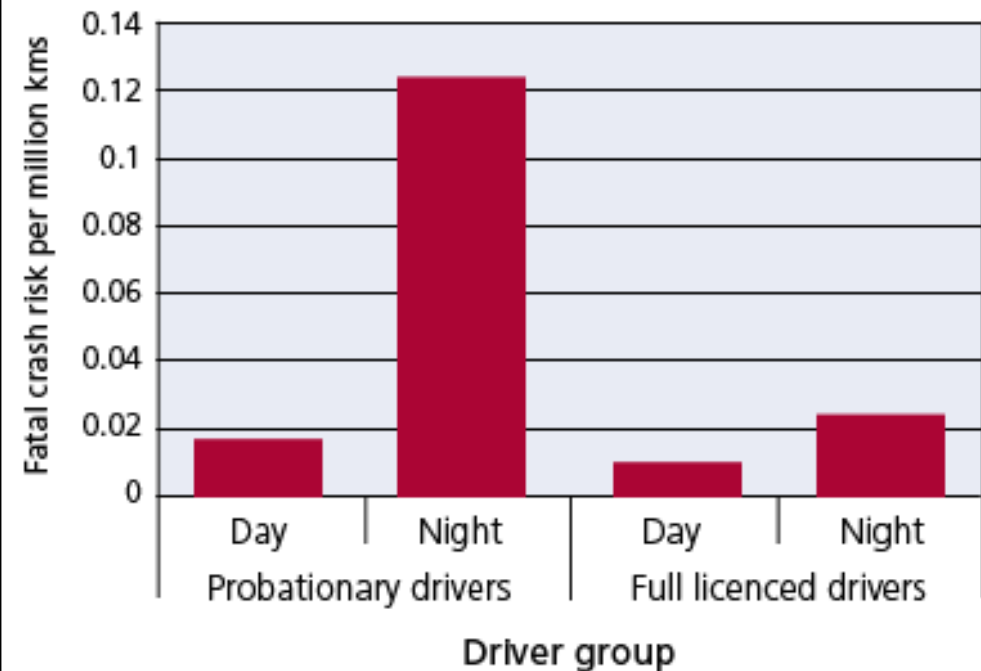
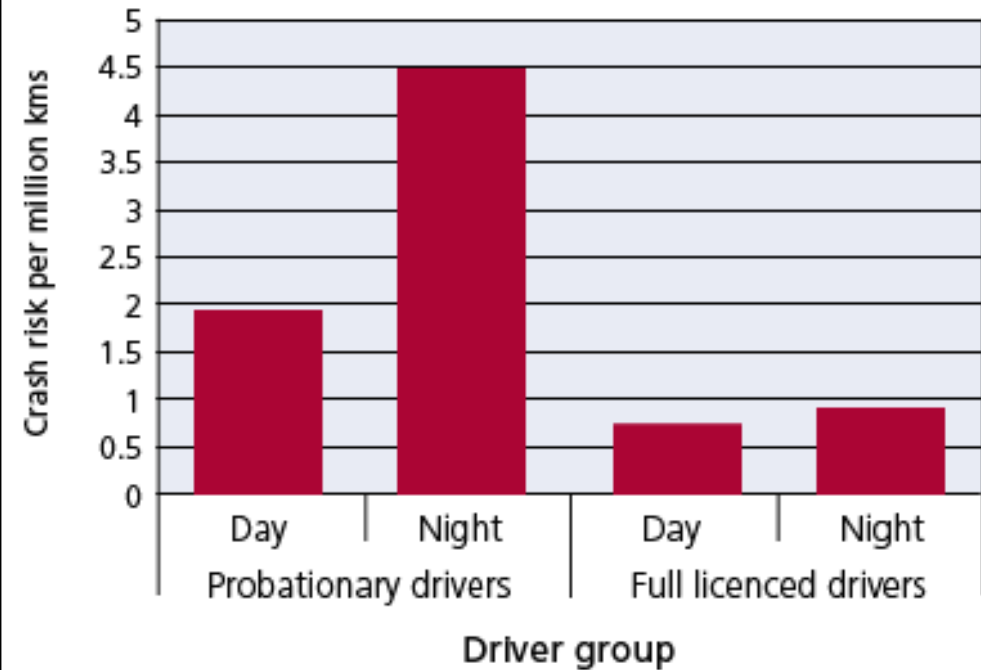
- get more sleep!
- some sleep is better than no sleep
- napping (even 15 minutes) is proven to improve performance
- caffeine for short runs
- avoiding shift work or planning it properly





## FACTS! : Victorian driver crash and fatal crash rates during the day (6am to 10pm) and night (10pm to 6am) by license type (VicRoads, 2005)

- The highest risk of death for young drivers involved in road crashes
- Study results :
  - People → inexperienced young drivers
  - Time → during the night-time hours; especially nearing midnight and into the early morning hours, and during these times on weekends.
  - Reasons :
    - poorer visual information,
    - fatigue and alcohol
    - “recreational” driving
    - less likely to use their seat belt
  - Young drivers also drive more at night compared to adult drivers
- **Solutions : support for restrictions**
  - Night-time driving restrictions are effective and should apply to first-year Provisional drivers from at least 11pm to 5am, with administrative exceptions.





SHIFTWORK  
SHIFTWORK



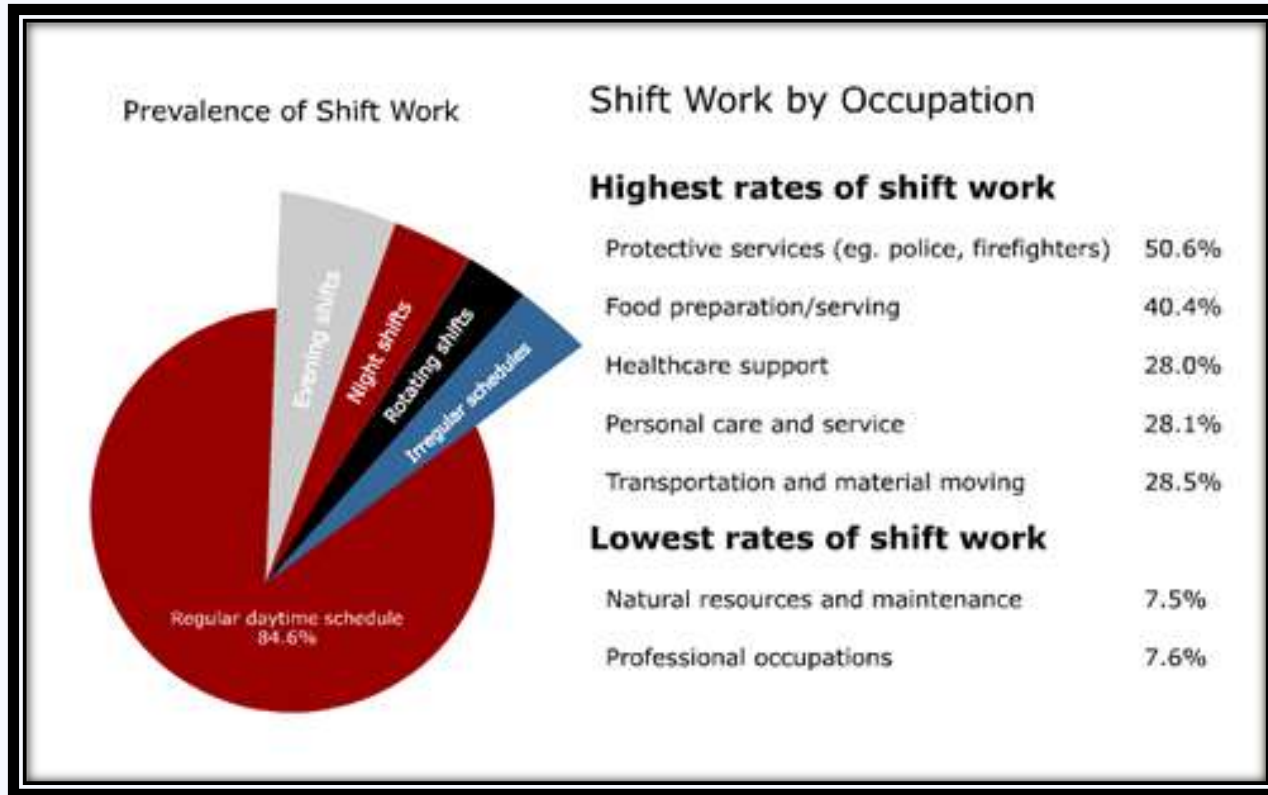
# What is Shift Work ?

- Shift work is work scheduled, either permanently or frequently outside normal daytime working hours (7 am.– 6 pm,) e.g. :
  - Permanent work at night
  - Permanent work during evening
  - Afternoon or evening shifts
  - Shifts beginning before 6 am.
  - Work hours with changing assignment patterns.



# Why Shift Work ?

To maintain continuity of process by a series of teams.



## Why Continuity ?

- Continuous (24 hours) nature of the technical process involved (nuclear reactors, steel production, oil refineries etc.)
- Public service (Hospitals, communication etc.)
- Purely economic reason – to make maximum use of the industrial plant.



# Shift Work Cycle

## Permanent Nights

- Most permanent night workers never really get used to the schedule
- Many nights they feel tired and sleepy
- Fatigue because of return to day hours on days off
- Family and friends active during the day
- Errands and chores during the day
- Sleep less during the day

## Rotating Shifts

- Can never adapt to a set work schedule
- Used to be more “fair” to all workers
- Rotating shift workers have more complaints than others about physical and psychological health
- Special Risks

# Special Features

- **Speed**

- The number of consecutive days before a shift change

- **Rotation**

- Longer rotations (3–4 weeks) may allow better adaptation to shift
- Shorter (1–2 days) allows no time to get used to night shift, but can get through it quickly to get to rest day. Used more in Europe than US

- **Direction**

- Forward or clockwise (day–evening–night)
- Reverse (day–night–evening)

- **Work–Rest Ratio**

- If an 8 hour shift = 16 hours to do everything else and sleep
- If a 12 hour shift, only 12 hours to do everything else.
- Family duties do not decrease no matter the shift time leading to less sleep and rest
- Fatigue is cumulative



# Unpredictable Schedules

- Health care workers with emergencies or covering call
- A factory breakdown or last minute rush order
- A last minute “call board” assignment to move an order
- Being on call and getting called in (Doctors do know about this!)



# Example of Shift Work :









## 2 Team Fixed 12 Plan

- This is a fixed (no rotation) plan that uses 2 teams and two 12-hr shifts to provide 24/7 coverage. One team will be permanently on the day shift and the other will be on the night shift.

Team	Days 1-1	Hours	Shifts
Team 1		12.0	<div></div> Day Shift (12 Hrs) 7:00 AM-7:00 PM
Team 2		12.0	<div></div> Night Shift (12 Hrs) 7:00 PM-7:00 AM
Total Hours		24.0	24.0

# Example of Shift Work : DNO Plan





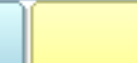
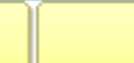

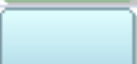
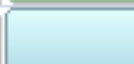
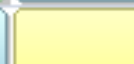
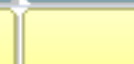
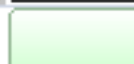
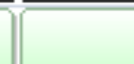

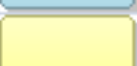
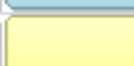











- This is a fast rotation plan that uses 3 teams
- Two 12-hr shifts to provide 24/7 coverage.
- Each team rotates through the following sequence every three days: 1 day shift, 1 night shift, and 1 day off.

Team	Days 1-3			Hours	Shifts
Team 1				24.0	 Day Shift (12 Hrs) 7:00 AM-7:00 PM
Team 2				24.0	 Night Shift (12 Hrs) 7:00 PM-7:00 AM
Team 3				24.0	
Total Hours			72.0	72.0	





































































































# Example of Shift Work : Metropolitan Rota (2-2-2)

- This is a fast rotation plan that uses 4 teams
- Three 8-hr shifts to provide 24/7 coverage
- Each team rotates through a sequence of 2 day shifts, 2 swing shifts, 2 night shifts, and 2 days off over an 8-day cycle.

Team	Days 1-8								Hours	Shifts
Team 1									48.0	 Day Shift (8 Hrs) 7:00 AM-3:00 PM
Team 2									48.0	 Swing Shift (8 Hrs) 3:00 PM-11:00 PM
Team 3									48.0	 Night Shift (8 Hrs) 11:00 PM-7:00 AM
Team 4									48.0	
Hours	192.0								192.0	

# Example of Shift Work : Continental Rota (2-2-3)

- This is a fast rotation plan that uses 4 teams
- Three 8-hr shifts to provide 24/7 coverage.
- Each team rotates through a sequence of 2, 2, and 3 consecutive day shifts, swing shifts, night shifts, or days off.
  - Week 1: 2 day shifts, 2 swing shifts, 3 night shifts
  - Week 2: 2 days off, 2 day shifts, 3 swing shifts
  - Week 3: 2 night shifts, 2 days off, 3 day shifts
  - Week 4: 2 swing shifts, 2 night shifts, 3 days off

Team	Days 1-7	Days 8-14	Days 15-21	Days 22-28	Hours	Shifts
Team 1	      	     	     	     	168.0	
Team 2	     	     	     	     	168.0	
Team 3	     	     	     	     	168.0	
Team 4	   	     	     	     	168.0	
Hours	168.0	168.0	168.0	168.0	672.0	

# Shift Work vs. Human Health

- Circadian De-synchronisation: shift work is counter to circadian rhythms
- Issues: alertness, hunger patterns, urinary patterns, quality of sleep, cardiac health, asthma
- Shifts are easier for younger person, older people have less physiological capacity to adapt shift work.
- Solutions :
  - permanent assignment (people don't usually like this)
  - slow rotation
  - fixed for 2-3 weeks then time to resynchronize between shifts

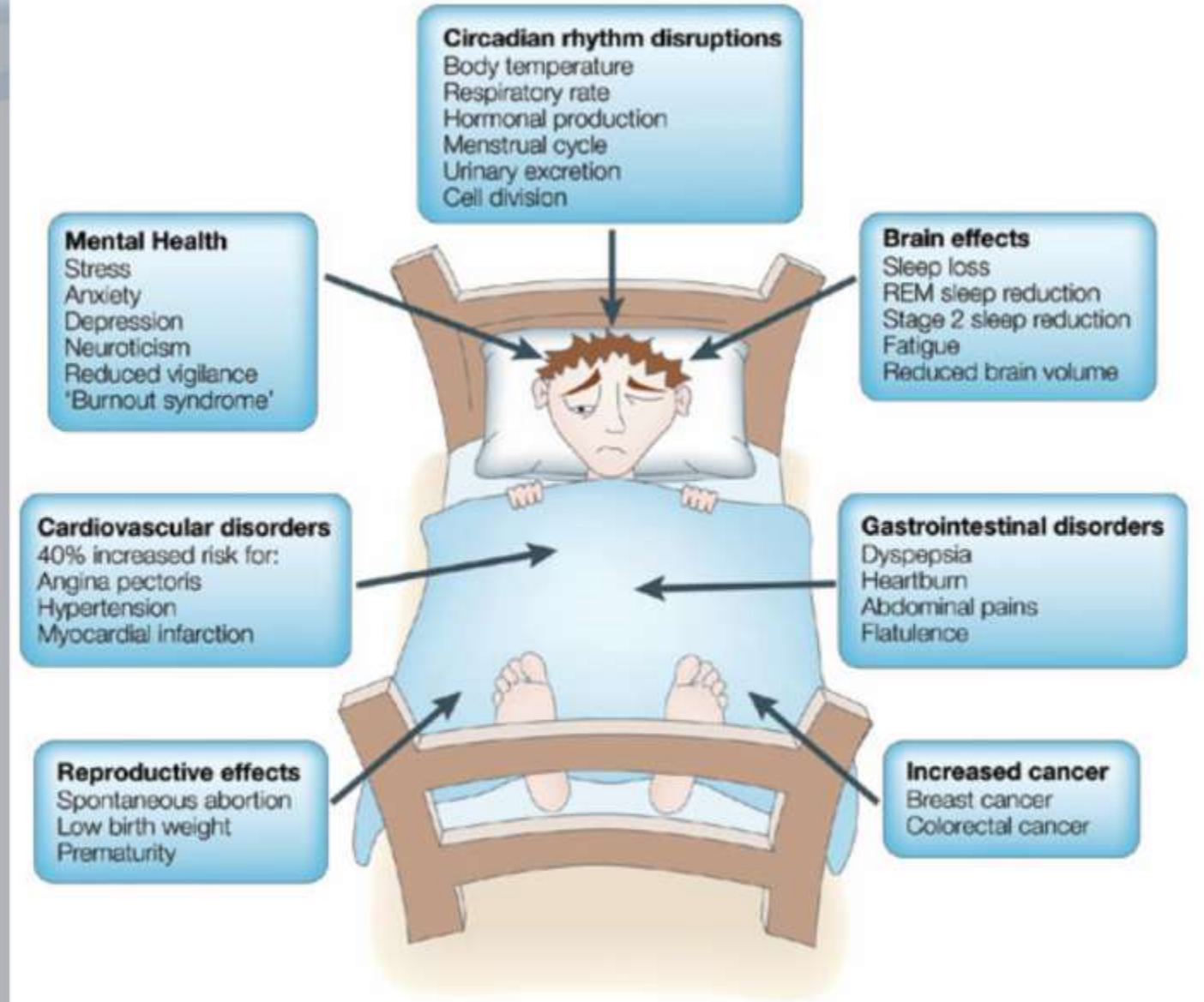


# De-synchronization

- Definition : *if we work in the night shift but our body rhythm is in day mode*
- When we sleep in day after night work :
  - Body temperature is increasing.
  - Digestive enzyme secretion is increasing.
  - Body metabolism is increasing.
  - Sleep is very difficult even if we are tired.
- Leads to :
  - Fatigue
  - Poor concentration
  - Impaired digestion
  - Difficult sleep

# People who **shouldn't** do shift work

- Over 40
- Cardiac problems
- Asthma
- Diabetes
- Epilepsy
- Past experience with depression



# Some Major Early Morning Accidents

- **Three Mile Island Accident (1979)** – a partial nuclear meltdown accident began at 4.0 am.
- **The Chernobyl Disaster (1986)** – catastrophic nuclear accident began at 01.23 am.
- **Sinking of the RMS Titanic (1912)** – struck an iceberg at 23.40 (ship time)
- **The Union Carbide chemical accident in Bhopal (1984)**– toxic gas leaking from an American-owned insecticide plant began at 1 am.

- ✓ Alertness and concentration are lowest at very early morning hours 3 – 6 am.
- ✓ Be aware of this fact. Work very carefully and deliberately.
- ✓ Double check everything. Double check verbal orders from your sleepy supervisors also.



# Hazards of Night Shift

## Biological

- Sleep deprivation.
- Gastric and digestive disorders.
- Vague symptoms – malaise, irritability, fatigue, muscular pain, not feeling normal, asthma
- Increases in cardio – vascular diseases.
- Poor pregnancy outcome.
- Shift mal-adaption syndrome

## Physiological

- Psychomotor performance is significantly affected
- For persons with diurnal orientation, jobs done less efficiently during night –
  - Jobs involving vigilance, manual dexterity, boring repetitive tasks, long term memory and fast reaction time.
  - Short term memory may improve during night

## Social

- Drug and alcohol abuse
- Divorce and souse abuse
- Cut off from the community
- Can not effectively participate in social life
- Can not fulfill collective responsibilities
- All family members can not get together and organize family life
- Neighborhood relations and group entertainment suffer

# Advantages of Night Shift

**Less supervision,  
more independence  
at night**

**Less politics**

**Able to attend day  
classes**

**If night-shift  
allowance is given,  
increase in income.**

**More useable  
daylight hours**

# Strategy No. 1

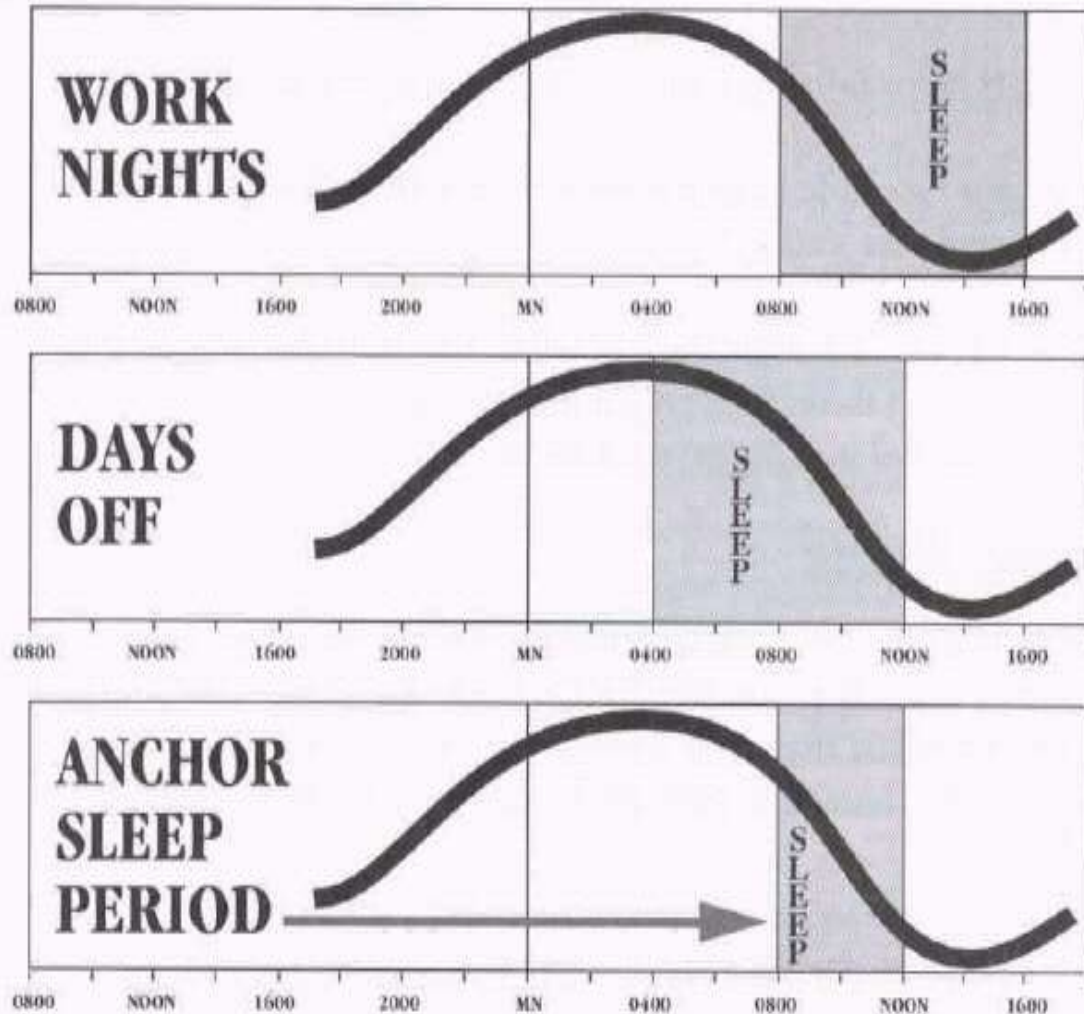
## Develop Night Life Style

- Theoretically, continuous night-shifts are better because you can adapt your body rhythms to a regular schedule
- In 7 – 8 days circadian rhythm is totally inverted.
- Maintain this schedule consistently on days off too.
- Reverting to a “normal” daytime schedule may harm you.
- Practically because of social and family responsibilities maintaining continuous night life style is never possible.
- Man is a social animal.



## THE COMPROMISE SOLUTION

### An Anchor Sleep Period



## Strategy No. 2

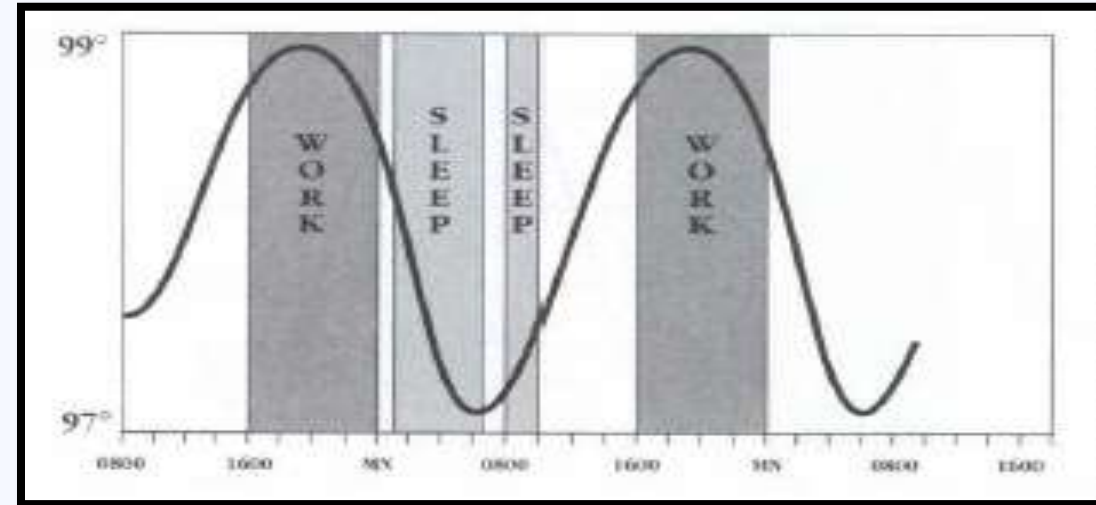
### An Anchor Sleep Period

- On work days – sleep 8 am to 4 pm
- On days off – delay your sleep (sleep from 4 am to noon).
- The anchor period overlaps 4 common hours with your night shift times.
- Better than totally flip flopping between days and nights.

# Strategy No. 3

## Split – Sleep

- If your shift schedule rotates at short interval, your body can not adapt quickly to sudden changes in biorhythms.
- The goal of split – sleep is to prevent body rhythms from shifting.
- When not working nights, sleep midnight to 8 am
- When working night shifts, split your sleep into 2 portions 8 am to noon and 6 pm to 9 pm.



### Advantages :

- Two sleep periods help to cancel the “Shift – effect” each has on body rhythms.
- You are sleeping close to end and beginning times of your usual sleep time. This maintains some consistency with cues.
- Some find sleeping right before shift, helps them stay alert and awake.

# The Sleep Environment

- Warm bath prior to bed.
- Sleep in a dark, quiet, cool and comfortable room.
- DO NOT DISTURB ME.
- Maintain a sleep schedule. Your family members and friends must know your sleep schedule.
- Develop a pre-bed time ritual – read newspaper, listen to soft music etc. This allows you to unwind from your shift.



# How to Remain Awake ?



Hot drinks tea or coffee.  
Caffeine is a stimulant.



If scheduled short naps  
are allowed during the  
shift. A short nap of 15 –  
20 minutes may increase  
your level of alertness.



Move around. Mild  
exercise during work.



Wash face with cold  
water.





# Nutrition Tips



- ✓ Shift workers are more susceptible to digestive problems. They develop irregular eating habits. They eat junk foods.
- ✓ At night, digestive system is at rest. Eating at night means eating when your digestive system is at rest.
- ✓ Carbohydrates are easily digested in comparison to fat and protein. Eat more of carbohydrate rich food at night. Avoid excessive fat and protein rich food at night.
- ✓ Bring easily digestible food from home.
- ✓ Take small amount at a time. Heavier meals are more difficult to digest.
- ✓ Avoid too much caffeine late in your shift. It can make it hard for you to fall asleep after you come back home.
- ✓ Try to eat one meal with family daily.
- ✓ Establish a meal schedule (normal for you)
- ✓ Eat at least 3 meals spaced at consistent intervals to fuel your body.



# SHIFTWORK

Find the Balance.



## Sleep

**We sometimes think we are ill or depressed, when we are actually just tired from lack of sleep.**

- Maintain regular sleep patterns
- Avoid caffeine, alcohol, nicotine and soft drinks
- Keep sleeping room dark, cool and quiet

## Food

**Eat nutritious foods.**

- Eat carbohydrates before sleeping and protein when you want to be alert
- Choose smaller meals
- Maintain a regular eating schedule

## Family

**Treat family time as important as any other commitment!**

- Post a family calendar
- Keep lines of communication open
- Inform partner of your schedule
- Be flexible in order to maintain good relationships
- Be positive. Your attitude influences those around you.
- Don't blame others for irritations related to fatigue from shift work

## Health

**Fatigue-related stress has both short and long term physical effects. It also has an impact on our performance and behaviour.**

- Maintain a healthy weight and good level of physical fitness
- Consult your doctor if sleep disorders or other health problems persist
- Remember to laugh and have fun

## Time Management

**Develop skills to use your time in the most productive way.**

- Learn to say NO!
- Prioritize activities and delegate
- Planning leads to efficiency and success
- Plan time for yourself



SGEU Shift Work  
Committee 2010  
[www.sgeu.org](http://www.sgeu.org)

# Administrative Controls

1. Limit shift work to essential jobs
2. Schedule toughest most dangerous tasks for early in the shift.  
Less demanding tasks for later in the shift
3. Avoid scheduling demanding or dangerous tasks at the beginning of an early morning shift
4. Tailor supervision:
  - Extra supervision between 3:30 AM and 5:30 AM
  - Younger workers have more accidents at the start of a shift following weekends
  - Older workers have more accidents at the end of a shift.
  - Supervise inexperienced workers more closely until they learn their job



# Engineering Controls

- Reduce night traffic, noise and distractions
- Be aware of hazards. Calculate toxic exposures based upon shift duration (i.e.: 8H TWA vs. 12 hour shift)
- Promote alertness:
  - Keep area brightly lit
  - Reduce glare and reflective surfaces
  - If feasible, allow workers to play music that will keep them awake
- Maximizes safety and health controls
  - Good ventilation
  - Temperature control
  - Machine guarding
- Avoid isolating workers. Communicate often.
- Provide food preparation areas, rest areas, consider and exercise facility



# Provide Worker Education and Instruction

- Treat shift training like Hazcom
- Talk about health and safety difficulties
- Emphasize performance and accident risks
- Teach employees to recognize social and family problems



*Thank you...*

**Have an enjoy study and  
see you next week...**