October 21:

- Psyche comes from the Latin word for soul.
- At one point, the mind and the soul meant the same thing, but psychology changed that. Psychologists are studying the mind, not the soul.
- The closest thing psychologists study that is related to the soul is consciousness.
- People used to study consciousness. The very early form of psychology was the psychology of our internal experiences, introspection. Then, we hit behaviourism. Behaviourism said don't talk about consciousness, it's too squishy. We only talk about things we can deal scientifically. However, consciousness has come back, through the cognitive revolution. People are now very interested in consciousness again.
- The first problem with studying consciousness is that there are a lot of definitions to it. So, two people can say they are studying consciousness, but are actually studying two very different things.
- **Consciousness** can refer to:
    1. The state of being awake and alert. Patients in a coma are not conscious. This is more medical oriented.
    2. In a more general sense, being "aware" of something. So one could be conscious of the threat of global warming or conscious of food in front of you.
    3. In a more specific sense, the state of being aware of oneself, or at least one's own thoughts.
       I.e. To be self-conscious or self-aware.
    4. When used as an adjective, "conscious" thoughts or processes are typical linked to goals and the notion of behavioural control. To most psychologists, the unconscious processes are your habits.
- **Capture error** occurs when two potential actions share the same or similar initial sequences but one action is relatively unfamiliar and the other is a well-known and well-practiced action. (The latter is often carried out almost automatically or subconsciously.) Goals and habits can be in conflict.
- **Intentionality:** Consciousness is directed toward something.
- **Unity:** Consciousness is very hard to divide. Most people are only conscious of one thing at a time. The brain chooses which thing to focus on. We're very sensitive to sudden movement and it usually gets our attention.
- **Selectivity:** Only certain aspects of stimuli are brought into consciousness.
- **Transience:** It is difficult to keep consciousness from moving.
  William James referred to this as "**The stream of consciousness**".
- William James also said that you are conscious every minute of every day.
- Some of the challenges that psychology faces around the concept of consciousness are:
    1. It is the "squishiest" concept we have.
    2. **Subjective phenomenology/qualia**: The psychological study of subjective experience. B.F. Skinner and others thought that our subjective phenomenology is just an illusion. He believed that our mental events are

caused by physical events in the brain, but have no effects upon any physical events. This is known as **epiphenomenalism**.

3. **The mind/body problem**: We believe that there's a distinction between our mind and our consciousness. We have questions such as "How do thoughts and our brain interact?", "Do they even interact?", and "Are they separate worlds?" There are a lot of evidence that suggests that our thoughts and brain do interact in powerful ways. Han Selye, a Canadian psychologist who studied stress, said that stressful people are very unhealthy. This is important because stress is mental.
4. **The problem of other minds and the notion of theory of mind**: This is not empathy. We can never know what's in someone's mind, but we can see how other people behave and guess what's in their mind. The theory of mind is how well you can tell what other people are thinking, while empathy is a sharing of their emotional state. Psychopaths are very good at the theory of mind.

- The radial arm maze experiment is when researchers place a rat in the centre of a maze, where there are a lot of arms. In each arm, there's food. It has been found that after the rat goes into one arm, eats the food, and goes back to the centre, it won't go down the same arm again. It remembers which arm it went down. However, if you removed the rat's hippocampus, they sometimes will still go down the same arm.
- Rene Descarte said that the human body is like a complex biological machine, but we still have a soul that can control our actions.
- Often habits result from indoctrination, and not from rational (conscious) thought. I.e. Habits are formed by repetition.
- The Freudian notion of unconsciousness has a sensor that blocks things it thinks that your consciousness can't handle.
- The Freudian notion of unconsciousness has its own goals. However, to most psychologists, only the conscious has goals. So, the Freudian notion of unconsciousness seems too complex for most psychologists and scientists.
- The dichotic listening task is when you a participant puts on a headphone, but there are different sounds coming out of each side. The participant is asked to focus on one sound and to repeat what they heard. People can not listen to both sounds simultaneously. However, people could tell you what they listened to in one sound.

October 28:

- For dichotic listening tasks, people will only notice stuff in the ear that is not focusing on the sound if there was a dramatic perceptual change.
- Donald Broadbent discovered that the things we don't pay attention to, we hardly process at all. However, subsequent experiments showed that Broadbent's theory was too strong.
- Participants often notice their name when it's in the unattended channel.
- Participants will follow the "message" (semantic meaning) from the attended to the unattended ear.

- Our previous discussion of consciousness was focused on the normal conscious experience of an awake, sober, self-controlled individual, but normal consciousness can be altered by sleep, hypnosis, drugs and sensory perception.
- Why we sleep:
    - Psychologists don't really know why we sleep. While there is some truth to evolution, sometimes evolution-based arguments are too flexible.
    - One theory states that sleep must be very critical. We sleep for about 8 hours a day and during those 8 hours, we're defenseless. Therefore, sleep must play some very important role.
    - Another theory states that since vision is human's best sense and our vision is limited during the night, we can sleep during the night to conserve energy for the day.
- Stages of sleep:
    - There are 5 main stages of sleep.
    - The first stage is stage 1. This is about 4-5% of the time you will spend in phase 1. Light sleep. Muscle activity slows. Occasional muscle twitching. Brain waves have low amplitude and high frequency. (Alpha wave)
    - The next stage is stage 2. This is about 44-55% of the time you will spend in phase 1. Breathing pattern and heart rate slows. Slight decrease in body temperature. Starting to go to sleep.
    - The next stage is stage 3. This is about 4-6% of the time you will spend in phase 1. This is the beginning of deep sleep. Brain begins generating delta waves. Brain waves have high amplitude and low frequency.
    - The next stage is stage 4. This is about 12-15% of the time you will spend in phase 1. This is very deep sleep. Rhythmic breathing. Limited muscle activity. Brain produces delta waves. People sleepwalk in this phase.
    - The final stage is stage 5. This is known is REM sleep. This is about 20-25% of the time you will spend in phase 1. Rapid eye movement. Brainwaves speed up and dreaming occurs. Muscles relax and heart rate increases. Breathing is rapid and shallow. The electrical activity is similar to that of an awake person. However for most people, their body is paralyzed. For the people whose body is not paralyzed, they act out their dreams and can get hurt. For others, they may be conscious, but their body is paralyzed. As such, they lay awake, unable to move. This is called **sleep paralysis**.
- Most people wake up just as the paralyzing drug is exiting their body. This makes their body feel hard.
- Sometimes, our nightmares are connected to sleep paralysis. When the brain realizes that the body is paralyzed, it makes up stories to make sense of why the body is paralyzed.
- In stage 4, people might get **night terrors**. A person experiencing a night terror feel like they're about to die. People feel more scared in night terrors than nightmares.
- In stage 5, people might get nightmares.

- The sleep cycle is repeated many times during our sleep. The most likely order of sleep stages during the first 90 minutes of a night is Stages 1-2-3-4-3-2-REM.
- As you sleep longer, you sleep less time in deep sleep and more time in light sleep or REM.
- If you wake up naturally, you're more likely to remember your dreams. However, if you wake up by an alarm clock or your parents, depending on where you're at in the sleep cycle, you might remember or forget your dream. If you're in REM when you're woken up, you'll remember your dreams. Otherwise, you won't.
- Although proper sleep seems to be tied to good health, the link may be more psychological than physical, at least in the most simplistic terms.
- Habitual tasks seem to be immune to sleep disruption, only those that require deep thought seem to be affected by lack of sleep.
- Deep sleep is associated with learning of information.
- REM sleep is associated with learning of skills.
- **Insomnia** which is associated with a wide range of both cognitive impairments and health risks is often associated with worry, guilt or stress and can lead to addiction to sleep medications.
- **Parasomnias**, which includes somnambulism (sleep walking), is when a person does waking behaviours (walking, eating, etc) while sleeping. This usually occurs when the person is in Stage 4 sleep. This is linked to improper paralysis and usually motor activity synchrony.
- Hypnotic induction almost always begins with progressive relaxation. The resulting state of deep relaxation often makes the client open to suggestion and capable of experiencing rich imagery. A therapist can use this context to produce strong associations, or to walk through positive mental experiences, that can have an effect after the session.

Textbook:

- **Section 5.1 Biological Rhythms of Consciousness Wakefulness and Sleep:**
- **Consciousness** is a person's subjective awareness, including thoughts, perceptions, experiences of the world, and self-awareness.
- **Biological Rhythms:**
- Organisms have evolved **biological rhythms** that are neatly adapted to the cycles in their environment.
- **Circannual rhythms** are biological rhythms with a period length approximating to 1 year. Circannual rhythms are examples of **infradian rhythm**, which is any rhythm that occurs over a period of time longer than a day. In humans, the best-known infradian rhythm is the menstrual cycle.
- Most biological rhythms occur with a much greater frequency than once a month. For instance, heart rate, urination, and some hormonal activity occur in 90–120-minute cycles. These more frequent biological rhythms are referred to as **ultradian rhythms**.
- The biological rhythm that appears to have the most obvious impact upon our lives is a cycle that occurs over the course of a day. **Circadian rhythms** are internally driven daily cycles of approximately 24 hours affecting physiological and behavioural processes. They involve the tendency to be asleep or awake at

specific times, to feel hungrier during some parts of the day, and even the ability to concentrate better at certain times than at others.

- Night shift workers and night owls aside, we tend to get most of our sleep when it is dark outside because our circadian rhythms are regulated by daylight interacting with our nervous and endocrine (hormonal) systems. One key brain structure in this process is the **suprachiasmatic nucleus (SCN)** of the hypothalamus. Cells in the retina of the eye relay messages about light levels in the environment to the SCN. The pineal gland releases a hormone called **melatonin**, which peaks in concentration at nighttime and is reduced during wakefulness. Information about melatonin levels feeds back to the hypothalamus; this feedback helps the hypothalamus monitor melatonin levels so that the appropriate amount of this hormone is released at different times of the day. Cells in the retina send messages about light levels to the suprachiasmatic nucleus, which in turn relays the information to the pineal gland, which secretes melatonin.
- There are two explanations for our 24-hour rhythms:
    1. One is **entrainment**, when biological rhythms become synchronized to external cues such as light, temperature, or even a clock. Because of its effects on the SCN-melatonin system, light is the primary entrainment mechanism for most mammals. We tend to be awake during daylight and asleep during darkness. We're also influenced by the time on our clocks.
    2. The other is **endogenous rhythms**, biological rhythms that are generated by our body independent of external cues such as light. While most people possess an endogenous circadian rhythm that is 24–25 hours in length, some people have longer cycles, sometimes as long as 48-hour days.
- Although our sleep–wake cycle remains relatively close to 24 hours in length throughout our lives, some patterns within our circadian rhythms do change with age. Researchers have found that we need much less sleep, especially a type called REM sleep, as we move from infancy and early childhood into adulthood. Moreover, people generally experience a change in when they prefer to sleep. In your teens and 20s, many of you have or will become night owls who prefer to stay up late and sleep in. When given the choice, most people in this age range prefer to work, study, and play late in the day, and then awake later in the morning. Later in adulthood, many of you will find yourselves going to bed earlier and getting up earlier, and you may begin to prefer working or exercising before teenagers even begin to stir.
  People tend to spend progressively less time sleeping as they age. The amount of a certain type of sleep, REM sleep, declines the most.
- **The Stages of Sleep:**
- Sleep itself has rhythms. In order to measure these rhythms, scientists use **polysomnography**, a set of objective measurements used to examine physiological variables during sleep. Sleep cycles themselves are most often defined by the **electroencephalogram (EEG)**, a device that measures brain activity using sensors attached to the scalp. EEGs detect changes involving the ion channels on neurons. Ion channels are involved with receiving excitatory and

inhibitory potentials from other cells and are also involved with the transmission of an action potential down the axon. Each EEG sensor would receive input from hundreds (possibly thousands) of cells. The output of an EEG is a waveform, representing the overall activity of these groups of neurons. These waves can be described by their **frequency**, the number of up-down cycles every second, and their **amplitude**, the height and depth of the up-down cycle. **Beta waves**, high-frequency, low-amplitude waves (15–30 Hz), are characteristic of wakefulness. Their irregular nature reflects the bursts of activity in different regions of the cortex, and they are often interpreted as a sign that a person is alert. As the individual begins to shift into sleep, the waves start to become slower, larger, and more predictable; these **alpha waves** (8–14 Hz) signal that a person may be daydreaming, meditating, or starting to fall asleep. These changes in the characteristics of the waves continue as we enter deeper and deeper stages of sleep.

- The EEG signals during sleep move through four different stages. In stage 1, brain waves slow down and become higher in amplitude. These are known as **theta waves** (4–8 Hz). Breathing, blood pressure, and heart rate all decrease slightly as an individual begins to sleep. However, at this stage of sleep, you are still sensitive to noises such as the television in the next room. After approximately 10 to 15 minutes, the sleeper enters stage 2, during which brain waves continue to slow. Stage 2 includes **sleep spindles** (clusters of high-frequency but low-amplitude waves) and **K complexes** (small groups of larger amplitude waves), which are detected as periodic bursts of EEG activity. What these bursts in brain activity mean is not completely understood, but evidence suggests they may play a role in helping maintain a state of sleep and in the process of memory storage. As stage 2 sleep progresses, we respond to fewer and fewer external stimuli, such as lights and sounds. Approximately 20 minutes later, we enter stage 3 sleep, in which brain waves continue to slow down and assume a new form called **delta waves** (large, looping waves that are high-amplitude and low-frequency—typically less than 3 Hz). The process continues with the deepest stage of sleep, stage 4, during which time the sleeper will be difficult to awaken. About an hour after falling asleep, we reach the end of our first stage 4 sleep phase. At this point, the sleep cycle goes in reverse and we move back toward stage 2. From there, we move into a unique stage of **REM sleep**, a stage of sleep characterized by quickening brain waves, inhibited body movement, and rapid eye movements (REM). This stage is sometimes known as paradoxical sleep because the EEG waves appear to represent a state of wakefulness despite the fact that we remain asleep. The REM pattern is so distinct that the first four stages are known collectively as non-REM (NREM) sleep. At the end of the first REM phase, we cycle back toward deep sleep stages and back into REM sleep again every 90 to 100 minutes.
- The most likely order of sleep stages during the first 90 minutes of a night of rest is Stages 1-2-3-4-3-2-REM.
- The deeper stages of sleep (3 and 4) predominate during the earlier portions of the sleep cycle, but gradually give way to longer REM periods.

- Brain waves, as measured by the frequency and amplitude of electrical activity, change over the course of the normal circadian rhythm. Beta waves are predominant during wakefulness but give way to alpha waves during periods of calm and as we drift into sleep. Theta waves are characteristic of stage 1 sleep. As we reach stage 2 sleep, the amplitude (height) of brain waves increases. During deep sleep (stages 3 and 4), the brain waves are at their highest amplitude. During REM sleep, they appear similar to the brain waves occurring when we are awake.
- Our sleep stages progress through a characteristic pattern. The first half of a normal night of sleep is dominated by deep, slow-wave sleep. REM sleep increases in duration relative to deep sleep during the second half of the night.
- **Why Do We Need Sleep:**
- The most intuitive explanation for why we sleep is probably the **restore and repair hypothesis**, the idea that the body needs to restore energy levels and repair any wear and tear experienced during the day's activities. Research on sleep deprivation clearly shows that sleep is a physical and psychological necessity. A lack of sleep eventually leads to cognitive decline, emotional disturbances, and impaired functioning of the immune system. It appears that sleeping helps animals, including humans, clear waste products and excess proteins from the brains.
- A second explanation for sleep, the **preserve and protect hypothesis**, suggests that two more adaptive functions of sleep are preserving energy and protecting the organism from harm. To support this hypothesis, researchers note that the animals most vulnerable to predators sleep in safe hideaways during the time of day when their predators are most likely to hunt. Because humans are quite dependent upon vision, it made sense for us to sleep at night, when we would be at a disadvantage compared to nocturnal predators.
- **Sleep Deprivation and Sleep Displacement:**
- **Sleep deprivation** occurs when an individual cannot or does not sleep. It can be due to some external factor that is out of your control or to some self-inflicted factor.
- The problems associated with sleep deprivation aren't limited to your ability to think. Research with adolescents shows that for every hour of sleep deprivation, predictable increases in physical illness, family problems, substance abuse, and academic problems occur. Issues also arise with your coordination, a problem best seen in studies of driving ability. Using a driving simulator, researchers found that participants who had gone a night without sleeping performed at the same level as people who had a blood-alcohol level of 0.07. Given that sleep deprivation is as dangerous as driving while mildly intoxicated, it is not surprising that it is one of the most prevalent causes of fatal traffic accidents.
- Cognitive and coordination errors are not limited to situations involving full or partial sleep deprivation. They can also occur when the timing of our sleep is altered. This phenomenon, **sleep displacement**, occurs when an individual is prevented from sleeping at the normal time although she may be able to sleep earlier or later in the day than usual.

- **Jet lag** is the discomfort a person feels when their sleep cycles are out of synchronization with light and darkness.
- It is typically easier to adjust when travelling west. When travelling east, a person must try to fall asleep earlier than usual, which is difficult to do. Most people find it easier to stay up longer than usual, which is what westward travel requires.
- **The Psychoanalytic Approach:**
- One of the earliest and most influential theories of dreams was developed by Sigmund Freud in 1899 in his novel, The Interpretation of Dreams. Freud viewed dreams as an unconscious expression of wish fulfillment. He believed that humans are motivated by primal urges, with sex and aggression being the most dominant. Because giving in to these urges is impractical/immoral/illegal most of the time, we learn ways of keeping these urges suppressed and outside of our conscious awareness. When we sleep, however, we lose the power to suppress our urges. Without this active suppression, these drives are free to create the vivid imagery found in our dreams. This imagery can take two forms:
    1. **Manifest content** involves the images and storylines that we dream about. In many of our dreams, the manifest content involves sexuality and aggression, consistent with the view that dreams are a form of wish fulfillment. In other cases, the manifest content of dreams might seem like random, bizarre images and events. However, Freud would argue that these images are anything but random; instead, he believed they have a hidden meaning.
    2. **Latent content** is the actual symbolic meaning of a dream built on suppressed sexual or aggressive urges. Because the true meaning of the dream is latent, Freud advocated **dream work**, the recording and interpreting of dreams. Through such work, Freudian analysis would allow you to bring the previously hidden sexual and aggressive elements of your dreams into the forefront.
- **The Activation–Synthesis Hypothesis:**
- Freud saw deep psychological meaning in the latent content of dreams. In contrast, the **activation–synthesis hypothesis** suggests that dreams arise from brain activity originating from bursts of excitatory messages from the pons, a part of the brainstem. This electrical activity produces the telltale signs of eye movements and patterns of EEG activity during REM sleep that resemble wakefulness; moreover, the burst of activity stimulates the occipital and temporal lobes of the brain, producing imaginary sights and sounds, as well as numerous other regions of the cortex. Thus, the brainstem initiates the activation component of the model. The synthesis component arises as different areas of the cortex of the brain try to make sense of all the images, sounds, emotions, and memories.
- The pons, located in the brainstem, sends excitatory messages through the thalamus to the sensory and emotional areas of the cortex. The images and emotions that arise from this activity are then woven into a story. Inhibitory signals are also relayed from the pons down the spinal cord, which prevents movement during dreaming.

- If the cortex is able to provide a temporary structure to input from the brainstem and other regions of the brain, then that means the brain is able to work with and restructure information while we dream.
- Interestingly, REM sleep is not the only stage of sleep that affects our ability to learn. There is some evidence that the sleep spindles found in stage 2 sleep are involved with learning new movements.
- **Working the Scientific Literacy Model Dreams, REM Sleep, and Learning:**
- The activation–synthesis model of dreaming suggests that our dreams result from random brainstem activity that is organized, to some degree, by the cortex. Although this theory is widely accepted, it doesn't provide many specifics about the purpose of dreams. Dream researcher Rosalind Cartwright proposed the **problem-solving theory**, the theory that thoughts and concerns are continuous from waking to sleeping, and that dreams may function to facilitate finding solutions to problems encountered while awake. This theory suggests that many of the images and thoughts we have during our dreams are relevant to the problems that we face when we are awake. Although no one doubts that our daily concerns find their way into our dreams, the problem-solving theory does not explain if or how any specific cognitive mechanisms are influenced by dreaming. In contrast, increasing evidence suggests that REM sleep, the sleep stage involved with dreaming, is essential for a number of cognitive functions.
- Approximately 20–25% of our total sleep time is taken up by REM, or rapid eye movement, sleep. When we are deprived of REM sleep, we typically experience **REM rebound**, our brains spend increased time in REM-phase sleep when given the chance. The fact that our bodies actively try to catch up on missed REM sleep suggests that it may serve an important function.
- REM sleep produces brainwaves similar to being awake, yet we are asleep. This similarity suggests that the types of functions being performed by the brain are likely similar during the two states. Studies with animals have shown that REM sleep is associated with a number of different neurotransmitter systems, all of which influence activity in the brainstem. Projections from the brainstem can then affect a number of different functions, including movement, emotional regulation, and learning.
- Several studies have shown that the amount of REM sleep people experience increases the night after learning a new task.
- Research has also demonstrated that REM sleep and dreaming also influence our ability to problem solve.
- **Insomnia:**
- The most widely recognized sleeping problem is **insomnia**, a disorder characterized by an extreme lack of sleep.
- Although the average adult may need 7 to 8 hours of sleep to feel rested, substantial individual differences exist. For this reason, insomnia is defined not in terms of the number of hours of sleep, but rather in terms of the degree to which a person feels rested during the day. If a person feels that her sleep disturbance is affecting her schoolwork, her job, or her family and social life, then it is indeed a problem. However, for this condition to be thought of as a sleep disorder, it

would have to be present for three months or more—one or two “bad nights” is unpleasant, but is not technically insomnia.

- Although insomnia is often thought of as a single disorder, it may be more appropriate to refer to insomnias in the plural. **Onset insomnia** occurs when a person has difficulty falling asleep (30 minutes or more), **maintenance insomnia** occurs when an individual cannot easily return to sleep after waking in the night, and **terminal insomnia/early morning insomnia** is a situation in which a person wakes up too early—sometimes hours too early—and cannot return to sleep.
- It is important to remember that for a sleep disorder to be labelled insomnia, the problems with sleeping must be due to some internal cause. Sometimes insomnia occurs as part of another problem, such as depression, pain, developmental disorders such as attention deficit hyperactivity disorder (ADHD), or various drugs. in these cases, the sleep disorder is referred to as a **secondary insomnia**.
- When insomnia is the only symptom that a person is showing, and other causes can be ruled out, physicians would label the sleep disorder as **insomnia disorder.**
- **Nightmares and Night Terrors:**
- **Nightmares** are particularly vivid and disturbing dreams that occur during REM sleep. They can be so emotionally charged that they awaken the individual.
- Data from numerous studies indicate that nightmares are correlated with psychological distress including anxiety, negative emotionality, and emotional reactivity.
- Nightmares are more common in females, likely because women tend to have higher levels of depression and emotional disturbances. In individuals with emotional disorders, the “synthesis” part of dreaming appears to reorganize information in a way consistent with their mental state, with a focus on negative emotion.
- **Night terrors** are intense bouts of panic and arousal that awaken the individual, typically in a heightened emotional state.
- These episodes occur during NREM sleep, and the majority of people who experience them typically do not recall any specific dream content. Night terrors increase in frequency during stressful periods. There is also some evidence linking them to feelings of anxiety.
- **Movement Disturbances:**
- To sleep well, an individual needs to remain still. During REM sleep, the brain prevents movement by sending inhibitory signals down the spinal cord. A number of sleep disturbances, however, involve movement and related sensations. For example, **restless legs syndrome** is a persistent feeling of discomfort in the legs and the urge to continuously shift them into different positions.
- A more common movement disturbance is **somnambulism/sleepwalking**, a disorder that involves wandering and performing other activities while asleep. It occurs during NREM sleep, stages 3 and 4, and is more prevalent during childhood. Sleepwalking is not necessarily indicative of any type of sleep or emotional disturbance, although it may put people in harm’s way. People who

sleepwalk are not acting out dreams, and they typically do not remember the episode. It is not dangerous to wake up a sleepwalker, as is commonly thought. At worst, he or she will be disoriented. There is no reliable medicine that curbs sleepwalking; instead, it is important to add safety measures to the person's environment so that the sleepwalker doesn't get hurt.

- A similar, but more adult, disorder is **sexomnia/sleep sex**. Individuals with this condition engage in sexual activity such as the touching of the self or others, vocalizations, and sex-themed talk while in stages 3 and 4 sleep.
- Another potentially dangerous condition is **REM behaviour disorder**. People with this condition do not show the typical restriction of movement during REM sleep; in fact, they appear to be acting out the content of their dreams. Unlike sleepwalking and restless legs syndrome, REM behaviour disorder can be treated with medication; benzodiazepines, which inhibit the central nervous system, have proven effective in reducing some of the symptoms associated with this condition.
- **Sleep Apnea:**
- **Sleep apnea** is a disorder characterized by the temporary inability to breathe during sleep.
- Although a variety of factors contribute to sleep apnea, this condition appears to be most common among overweight and obese individuals, and it is roughly twice as prevalent among men as among women.
- In most cases of apnea, the airway becomes physically obstructed at a point anywhere from the back of the nose and mouth to the neck. Therefore, treatment for mild apnea generally involves dental devices that hold the mouth in a specific position during sleep. Weight-loss efforts should accompany this treatment in cases in which it is a contributing factor. In moderate to severe cases, a continuous positive airway pressure (CPAP) device can be used to force air through the nose, keeping the airway open through increased air pressure.
- In rare but more serious cases, sleep apnea can also be caused by the brain's failure to regulate breathing. This failure can happen for many reasons, including damage to or deterioration of the medulla of the brainstem, which is responsible for controlling the chest muscles during breathing.
- **Narcolepsy:**
- **Narcolepsy** is a disorder in which a person experiences extreme daytime sleepiness and even sleep attacks.
- These bouts of sleep may last only a few seconds, especially if the person is standing or driving when she falls asleep and is jarred awake by falling, a nodding head, or swerving of the car. Even without such disturbances, the sleep may last only a few minutes or more, so it is not the same as falling asleep for a night's rest.
- Narcolepsy differs from more typical sleep in a number of other ways. People with a normal sleep pattern generally reach the REM stage after more than an hour of sleep, but a person experiencing narcolepsy is likely to go almost immediately from waking to REM sleep. Also, because REM sleep is associated

with dreaming, people with narcolepsy often report vivid dream-like images even if they did not fully fall asleep.

- Individuals with narcolepsy have fewer brain cells that produce orexin, a hormone that functions to maintain wakefulness, resulting in greater difficulty maintaining wakefulness.
- **Overcoming Sleep Problems:**
- Fortunately, most people respond very well to psychological interventions. By practising good **sleep hygiene**, healthy sleep-related habits, they can typically overcome sleep disturbances in a matter of a few weeks.
- While alcohol can make you sleepy, it disrupts the quality of sleep, especially the REM cycle, and may leave you feeling unrested the next day.
- Many people turn to drugs to help them sleep. A number of sleep aids are available on an over-the-counter basis, and several varieties of prescription drugs have been developed as well. Although these drugs managed to put people to sleep, several problems with their use were quickly observed. Notably, people quickly developed tolerance to these agents, meaning they required increasingly higher doses to get the same effect, and many soon came to depend on the drugs so much that they could not sleep without them.
- **Here are some Non-pharmacological Techniques for Improving Sleep:**
    1. Use your bed for sleeping only, not for working or studying.
    2. Do not turn sleep into work. Putting effort into falling asleep generally leads to arousal instead of sleep.
    3. Keep your clock out of sight. Watching the clock increases pressure to sleep and worries about getting enough sleep.
    4. Get exercise early during the day. Exercise may not increase the amount of sleep, but it may help you sleep better. Exercising late in the day, however, may leave you restless and aroused at bedtime.
    5. Avoid substances that disrupt sleep. Such substances include caffeine (in coffee, tea, many soft drinks, and other sources), nicotine, and alcohol. Illicit drugs such as cocaine, marijuana, and ecstasy also disrupt healthy sleep.
    6. If you lie in bed worrying at night, schedule evening time to deal with stress. Write down your worries and stressors for approximately 30 minutes prior to bedtime.
    7. If you continue to lie in bed without sleeping for 30 minutes, get up and do something else until you are about to fall asleep, and then return to bed.
    8. Get up at the same time every morning. Although this practice may lead to sleepiness the first day or two, eventually it helps set a daily rhythm.
    9. If you still have problems sleeping after four weeks, consider seeing a sleep specialist to get tested for sleep apnea, restless legs syndrome, or other sleep problems that may require more specific interventions.

- **Section 5.2: Altered States of Consciousness Hypnosis, Mind-Wandering, and Disorders of Consciousness:**
- **Hypnosis:**
- **Hypnosis** is a procedure of inducing a heightened state of suggestibility.
- Hypnosis is not a trance
- Hypnotic suggestions generally are most effective when they fall into one of three categories:
    1. **Ideomotor suggestions** are related to specific actions that could be performed, such as adopting a specific position.
    2. **Challenge suggestions** indicate actions that are not to be performed, so that the subject appears to lose the ability to perform an action.
    3. **Cognitive-perceptual suggestions** involve a subject remembering or forgetting specific information, or experiencing altered perceptions such as reduced pain sensations.
- It is important to note that hypnotists cannot make someone do something against their will.
  E.g. The hypnotist could not suggest that an honest person rob a bank and expect the subject to comply. Instead, the hypnotist can increase the likelihood that subjects will perform simple behaviours that they have performed or have thought of before, and would be willing to do, in some contexts, when in a normal conscious state.
- **Theories of Hypnosis:**
- The word hypnosis comes from the Greek word hypno, meaning “sleep.” However, in reality, scientific research tells us that hypnosis is nothing like sleep. Instead, hypnosis is based on an interaction between:
    1. Automatic (unconscious) thoughts and behaviours.
    2. A supervisory system sometimes referred to as **executive processing**, which is involved in processes such as the control of attention and problem solving
- **Dissociation theory** explains hypnosis as a unique state in which consciousness is divided into two parts: a lower-level system involved with perception and movement and an “executive” system that evaluates and monitors these behaviours.
- This kind of divided state is actually quite common. Take any skill that you have mastered, such as driving a car or playing an instrument. When you began, it took every bit of your conscious awareness to focus on the correct movements—you were a highly focused observer of your actions. In this case, your behaviour required a lot of executive processing. After a few years of practice, you can do it automatically while you observe and pay attention to something else. In this case, you require much less executive processing. Although we call the familiar behaviour automatic, part of you is still paying attention to what you are doing in case you suddenly need to change your behaviour.

- During hypnosis, there appears to be a separation between these two systems. As a result, actions or thoughts suggested by the hypnotist may bypass the evaluation and monitoring system and go directly to the simpler perception and movement systems. In other words, suggestible individuals will experience less input from the executive system. In support of this view, neuroimaging studies have found reduced activity in the anterior cingulate cortex, a region of the frontal lobe related to executive functions, in hypnotized subjects.
- A second approach, **social-cognitive theory**, explains hypnosis by emphasizing the degree to which beliefs and expectations contribute to increased suggestibility. This perspective is supported by experiments in which individuals who are not yet hypnotized are told either that they will be able to resist ideomotor suggestions or that they will not be able to resist them. In these studies, people tend to conform to what they have been told to expect—a result that cannot be easily explained by dissociation theory. Similarly, research on hypnosis as a treatment for pain shows that response expectancy, whether the individual believes the treatment will work, plays a large role in the actual pain relief experienced.
- **Applications of Hypnosis:**
- Hypnosis has been used to treat a number of different physical and psychological conditions. Hypnosis is often used in conjunction with other psychotherapies such as cognitive-behavioural therapy rather than as a stand-alone treatment. The resulting **cognitive hypnotherapy** has been used as an effective treatment for depression, anxiety, eating disorders, hot flashes of cancer survivors, and irritable bowel syndrome.
- Hypnosis is far from a cure-all.
- The best conclusion regarding hypnosis in therapy is that it shows promise, especially when used in conjunction with other evidence-based psychological or medical treatments.
- Perhaps the most practical use for hypnosis is in the treatment of pain. If researchers can demonstrate its effectiveness in this application, it may be a preferred method of pain control given painkillers' potential side effects and risk of addiction. Research has shown that hypnosis generally works as well as drug treatments for **acute pain**, which is the intense, temporary pain associated with a medical or dental procedure. The effect of hypnosis on chronic pain is more complicated, as some conditions are due to purely physical causes whereas others are more psychological in nature. For these latter conditions, it is likely that the patient will expect to continue to feel pain regardless of the treatment, thus reducing the effectiveness of hypnosis.
- Hypnosis does not improve memory. Today, responsible psychologists do not use hypnotherapy to uncover or reconstruct lost memories. Police officers have also largely given up this practice. In 2007, the Supreme Court of Canada ruled that testimony based on hypnosis sessions alone cannot be submitted as evidence.

- **Mind-Wandering:**
- **Mind-wandering** is the unintentional redirection of attention from one's current task to an unrelated train of thought.
- Several studies have shown that mind-wandering decreases reading comprehension.
- **Mind-Wandering and the Brain:**
- In the late 1990s, Marcus Raichle and his research team made a discovery that would change psychology. While looking at their brain-imaging data, Raichle noticed that a number of brain areas were active. But Raichle noticed something else in his data. He noticed that across a number of studies, the same pattern of deactivations also occurred.
  I.e. A network of brain regions became less active when participants performed a task.
  This network, now known as the **default mode network**, is a network of brain regions including the medial prefrontal cortex, posterior cingulate gyrus, and medial and lateral regions of the parietal lobe that is most active when an individual is awake but not responding to external stimuli.
  I.e. The default mode network is more active when a person is paying attention to his internal thoughts rather than to an outside stimulus or task.
- The default mode network also appears to be related to mind-wandering.
- However, the default mode network wasn't the only group of brain areas found to be active during mind-wandering. A network involving parts of the frontal and parietal lobes also showed increased activity when mind-wandering was occurring. This **frontoparietal network** is associated with goal-directed thinking such as planning for the future, as well as the control of attention.
- The default mode network is involved with self-related thinking. The frontoparietal network is linked with goal-directed thought and planning. Both are involved with mind-wandering.
- **The Benefits of Mind-Wandering:**
- Mind-wandering typically occurs during tasks that are repetitive, don't require much thought, and/or that we've experienced before. If we're not dedicating many mental resources to a given task, we will have more resources to dedicate to mind-wandering.
- One function of the frontal lobes is planning future goals and actions. As it turns out, mind-wandering is related to future thinking.
- **Disorders of Consciousness:**
- The lowest level of consciousness in a person who is still technically alive is known as **brain death**, a condition in which the brain, specifically including the brainstem, no longer functions. Individuals who are brain dead have no hope of recovery because the brainstem regions responsible for basic life functions like breathing and maintaining the heartbeat do not function

- In contrast to brain death, a **coma** is a state marked by a complete loss of consciousness. It is generally due to damage to the brainstem or to widespread damage to both hemispheres of the brain. Patients who are in a coma have an absence of both wakefulness and awareness of themselves or their surroundings. Some of the patient's brainstem reflexes will be suppressed, including pupil dilation and constriction in response to changes in brightness. Typically, patients who survive this stage begin to recover to higher levels of consciousness within 2–4 weeks, although there is no guarantee that the patient will make a full recovery.
- If a patient in a coma improves slightly, the individual may enter a **persistent vegetative state**, a state of minimal to no consciousness in which the patient's eyes may be open, and the individual will develop sleep–wake cycles without clear signs of consciousness. For example, vegetative state patients do not appear to focus on objects in their visual field, nor do they track movement. These patients generally do not have damage to the brainstem. Instead, they have extensive brain damage to the grey matter and white matter of both hemispheres, leading to impairments of most functions. The likelihood of recovery from a vegetative state is time dependent. If a patient emerges from this state within the first few months, he or she could regain some form of consciousness. In contrast, if symptoms do not improve after three months, the patient is classified as being in a **permanent vegetative state**; the chances of recovery from that diagnosis decrease sharply.
- There are two other disorders of consciousness that are often diagnosed by neurologists.
    1. **Minimally conscious state (MCS)**, a disordered state of consciousness marked by the ability to show some behaviours that suggest at least partial consciousness, even if on an inconsistent basis. A minimally conscious patient must show some awareness of himself or his environment, and be able to reproduce this behaviour. Examples of some behaviours that are tested are following simple commands, making gestures or yes/no responses to questions, and producing movements or emotional reactions in response to some person or object in their environment. When neuroimaging is used, minimally conscious patients show more activity than vegetative patients, including activity in some higher-order sensory and cognitive region.
    2. The disorder of consciousness that most resembles the healthy, awake state, at least in terms of awareness, is **locked-in syndrome**, a disorder in which the patient is aware and awake but, because of an inability to move his or her body, appears unconscious.
- **Working the Scientific Literacy Model Assessing Consciousness in the Vegetative State:**
- The initial assessment of consciousness in severely brain-damaged patients is generally performed at the patient's bedside. Doctors will perform tests of a patient's reflexes and examine other simple responses. The most common assessment tool is the **Glasgow Coma Scale (GCS)**, a 15-item checklist for the

physician. The GCS measures eye movements—whether they can open at all, open in response to pain, open in response to speech, or open spontaneously without any reason. The next five items on this checklist assess language abilities. The final six items measure movement abilities such as whether the patient responds to pain and whether she can obey commands. Scores of 9 or below reflect a severe disturbance of consciousness. For comparison, individuals suffering from a concussion tend to score between 13 and 15, which is labelled as a mild disturbance.

- Checklists such as the GCS provide a useful initial indicator of a brain-damaged patient's abilities. However, many of the behaviours measured by this and similar assessment tools focus more on overt behaviours than on direct indications of awareness. A patient's inability to move may imply a greater disturbance of consciousness than actually exists, thus leading to potential misdiagnoses. Improvements in brain-imaging techniques may prove to be a more sensitive tool for investigating consciousness.
- Researchers have argued for some time that some patients in a persistent vegetative state can show some signs of consciousness.
- The initial neuroimaging studies of consciousness in vegetative state patients are indeed promising. However, there are some important issues that need to be dealt with. First, we mentioned above that up to 43% of patients with disorders of consciousness are misdiagnosed. Given that a small subset of the vegetative state patients were able to modify their brain activity, it is possible that they were not actually in a vegetative state, but instead had a less severe condition. Second, the researchers are equating language abilities with consciousness; yet, consciousness could take the form of responses to other, non-linguistic stimuli. This criticism would be particularly important if a vegetative state patient had damage to brain areas related to language comprehension.
- We also have to be cautious about the use of PET and fMRI scans in patients with widespread brain damage. Both types of neuroimaging measure characteristics of blood flow in the brain. But, damage to the brain will alter how the blood flows; therefore, we need to be careful when comparing patients with healthy controls. One way around this latter concern is to use multiple methods of neuroimaging. Increasing numbers of research groups are using EEG, which measures neural activity using electrodes attached to the scalp, to search for brain function in vegetative patients. Given that distinct brain waves have been identified for sensory detection of a stimulus, the detection of unexpected auditory stimuli, higher-level analysis of stimuli, and semantic analysis of language, this technology could provide important insights into the inner worlds of vegetative state patients.
- **<u>Section 5.3 Drugs and Conscious Experience:</u>**
- **Physical and Psychological Effects of Drugs:**
- Your brain contains a number of different chemical messengers called neurotransmitters. These brain chemicals are released by the presynaptic neuron into the synapse, the space between the cells. They then bind to receptors on the surface of the postsynaptic neurons, thus making these neurons more or less

likely to fire. Drugs influence the amount of activity occurring in the synapse. Thus, they can serve as an **agonist**, which enhances or mimics the activity of a neurotransmitter, or as an **antagonist**, which blocks or inhibits the activity of a neurotransmitter.

- The short-term effects of drugs can be caused by a number of different brain mechanisms including:
    1. Altering the amount of the neurotransmitter being released into the synapse.
    2. Preventing the reuptake (reabsorption back into the cell that released it) of the neurotransmitter once it has been released, thereby allowing it to have a longer influence on other neurons.
    3. Blocking the receptor that the neurotransmitter would normally bind to.
    4. Binding to the receptor in place of the neurotransmitter.

  In all of these scenarios, the likelihood of the postsynaptic neurons firing is changed, resulting in changes to how we think, act, and feel.
- Different drugs will influence different neurotransmitter systems.
  E.g. Ecstasy primarily affects serotonin levels, whereas painkillers like OxyContin™ affect opioid receptors.
- However, the brain chemical that is most often influenced by drugs is dopamine, a neurotransmitter that is involved in responses to rewarding, pleasurable feelings. Dopamine release in two brain areas, the nucleus accumbens and the ventral tegmental area, is likely related to the “high” associated with many drugs. These positive feelings serve an important, and potentially dangerous, function: They reinforce the drug-taking behaviour. In fact, the dopamine release in response to many drugs makes them more rewarding than sex or delicious food. This reinforcing effect is so powerful that, for someone who has experience with a particular drug, even the anticipation of taking the drug is pleasurable and involves the release of dopamine.
- The nucleus accumbens and ventral tegmental area are associated with reward responses to many different drugs.
- However, the drug–neurotransmitter relationship is not as simple as it would seem because the effects of drugs involve biological, psychological, and social mechanisms. The setting in which drugs are consumed can also have a more sinister effect: Overdoses of some drugs are more common when they are taken in new environments than when they are taken in a setting that the person often uses for drug consumption. When people enter an environment that is associated with drug use, their bodies prepare to metabolize drugs even before they are consumed (their bodies become braced for the drug’s effects). Similar preparations do not occur in new environments, which leads to larger, and potentially fatal, drug effects. Another psychological factor that influences drug effects is the person’s experience with a drug. It takes time for people to learn to associate taking the drug with the drug’s effects on the body and brain. Therefore, a drug might have a much more potent effect on a person the third or fourth time he took it than it did the first time, which is very common with some

drugs, such as marijuana. Finally, a person's expectations about the drug can dramatically influence its effects.

- **Long-Term Effects:**
- The effects that different drugs will have on us change as we become frequent users.
- **Tolerance** occurs when repeated use of a drug results in a need for a higher dose to get the intended effect.
- Tolerance is the brain's attempt to keep the level of neurotransmitters at stable levels. When receptors are overstimulated by neurotransmitters, as often happens during drug use, the neurons fire at a higher rate than normal. In order to counteract this effect and return the firing rate to normal, some of the receptors move further away from the synapse so that they are more difficult to stimulate, a process known as **down-regulation**.
- Tolerance is not the only effect that can result from long-term use of legal or illegal drugs. Another is **physical dependence**, the need to take a drug to ward off unpleasant physical withdrawal symptoms. The characteristics of dependence and withdrawal symptoms differ from drug to drug. Caffeine withdrawal can involve head and muscle aches and impaired concentration. Withdrawal from long-term alcohol abuse is much more serious. A person who is dependent on alcohol can experience extremely severe, even life-threatening, withdrawal symptoms including nausea, increased heart rate and blood pressure, and hallucinations and delirium. Furthermore, drug dependence is not limited to physical symptoms. **Psychological dependence** occurs when emotional need for a drug develops without any underlying physical dependence. Many people use drugs in order to ward off negative emotions. When they no longer have this defence mechanism, they experience the negative emotions they have been avoiding, such as stress, depression, shame, or anxiety. Therefore, treatment programs for addiction often include some form of therapy that will allow users to learn to cope with these emotional symptoms while they are attempting to deal with the physical symptoms of withdrawal.
- At the biological level, researchers are attempting to identify the specific genes, or groups of genes, that make someone prone to becoming addicted to different drugs. For example, the A1 allele of the DRD2 gene, which influences the activity of dopamine receptors, is related to reward processing and to being open to new experiences and is also more common in people who are addicted to opioid drugs such as heroin. In contrast, researchers at the University of Toronto found that a protective version of the CYP2A6 gene is more common in people who do not smoke; this version of the gene is related to feelings of nausea and dizziness occurring when the person is exposed to smoking.
- Researchers are also examining cognitive factors affecting drug-taking behaviour. Dependence is influenced by the fact that drugs are often taken in the same situations.
- Addiction rates are also affected by social factors, such as the culture in which a person lives. Family attitudes toward drugs is a factor as well, as early experiences with different drugs can shape our attitudes toward them and

influence how we consume those drugs later in life. If a young person first tries wine in a family setting, it will feel much less like a cool part of teenage rebellion than if that person first tried the same drink at a high school house party. That initial introduction can alter how that person views alcohol for years to come.

- Drug dependence is also influenced by the social support available. A key factor in drug dependence is a feeling of isolation.
- Finally, all of these variables interact with a person's personality. Individuals with impulsive personality traits are more likely to become addicted to drugs regardless of their early experiences or cultural setting.
- **Commonly Abused "Recreational" Drugs:**

	Psychological Effects	**Chemical Effects**	**Tolerance**	**Likelihood of Dependence**
Stimulants: cocaine, amphetamine, ecstasy	Euphoria, increased energy, lowered inhibitions	Increase dopamine, serotonin, norepinephrine activity	Develops quickly	High
Marijuana	Euphoria, relaxation, distorted sensory experiences, paranoia	Stimulates cannabinoid receptors	Develops slowly	Low
Hallucinogens: LSD, psilocybin, DMT, ketamine	Major distortion of sensory and perceptual experiences. Fear, panic, paranoia	Increase serotonin activity Blocks glutamate receptors	Develops slowly	Very low
Opiates: heroin	Intense euphoria, pain relief	Stimulate endorphin receptors	Develops quickly	Very high
Sedatives: barbiturate, benzodiazepine	Drowsiness, relaxation, sleep	Increase GABA activity	Develops quickly	High
Alcohol	Euphoria, relaxation, lowered inhibitions	Primarily facilitates GABA activity; also stimulates endorphin and dopamine receptors	Develops gradually	Moderate to high

- **Psychoactive drugs** are substances that affect thinking, behaviour, perception, and emotion.

- Many common prescription medications are chemically similar, albeit safer, versions of illicit drugs. Additionally, many legal prescription drugs are purchased illegally and used in ways not intended by the manufacturer.
- **Stimulants:**
- **Stimulants** are a category of drugs that speed up the activity of the nervous system, typically enhancing wakefulness and alertness.
- There are a number of different types of stimulant drugs, ranging from naturally occurring substances such as leaves (cocaine) and beans (coffee) to drugs produced in a laboratory (crystal meth).
- The most widely used and abused stimulant is caffeine. However, caffeine is not a recreational drug.
- Caffeine tends to temporarily increase energy levels and alertness by influencing the activity of a brain chemical called **adenosine**. When adenosine binds to its receptors in the brain, it slows down neural activity. In fact, it helps you become sleepy. Caffeine binds to adenosine receptors, but without causing a reduction in neural activity. I.e. It prevents adenosine from doing its job. At the same time, caffeine stimulates the adrenal glands to release adrenaline. This hormone accounts for the burst of energy associated with caffeine. Given that adrenaline is also associated with “fight or flight” responses, it may also explain why many people feel jittery after consuming too much caffeine. Although no drug is harmless, the withdrawal effects associated with it are far less severe than those found for other stimulants. Depriving yourself of caffeine will typically result in headaches, fatigue, and occasionally nausea; however, these symptoms will usually disappear after two to three days.
- Cocaine is another commonly abused stimulant. It is synthesized from coca leaves, most often grown in South American countries such as Colombia, Peru, and Bolivia. The people who harvest these plants often take the drug in its simplest form—they chew on the leaves and experience a mild increase in energy. However, by the time it reaches Canadian markets, it has been processed into powder form. It is typically snorted and absorbed into the bloodstream through the nasal passages or, if prepared as crack cocaine, smoked in a pipe. Cocaine influences the nervous system by blocking the reuptake of dopamine in reward centres of the brain, although it can also influence serotonin and norepinephrine levels as well. By preventing dopamine from being reabsorbed by the neuron that released it, cocaine increases the amount of dopamine in the synapse between the cells, thus making the postsynaptic cell more likely to fire. The result is an increase in energy levels and a feeling of euphoria.
- Like many addictive drugs, cocaine and amphetamines stimulate the reward centres of the brain, including the nucleus accumbens and ventral tegmental area. Cocaine works by blocking reuptake of dopamine, and methamphetamine works by increasing the release of dopamine at presynaptic neurons.
- Amphetamines, another group of stimulants, come in a variety of forms. Some are prescription drugs, such as methylphenidate (Ritalin) and modafinil (Provigil), which are typically prescribed for attention deficit hyperactivity disorder (ADHD)

and narcolepsy, respectively. When used as prescribed, these drugs can have beneficial effects; oftentimes, however, these drugs are used recreationally.

- Methamphetamine, which stimulates the release of dopamine in presynaptic cells, may be even more potent than cocaine when it comes to addictive potential. Methamphetamines are also notorious for causing significant neurological and external physical problems. For example, chronic methamphetamine abusers often experience deterioration of their facial features, teeth, and gums, owing to a combination of factors. First, methamphetamine addiction can lead to neglect of basic dietary and hygienic care. Second, the drug is often manufactured from a potent cocktail of substances including hydrochloric acid and farm fertilizer—it is probably not surprising that these components can have serious side effects on appearance and health.
- Long-term use of potent stimulants like methamphetamines can actually alter the structure of the user's brain. Compared to non-users, people who have a history of abusing methamphetamine have been shown to have structural abnormalities of cells in the frontal lobes, which reduces the brain's ability to inhibit irrelevant thoughts. This ability can be measured through the Stroop test, which challenges a person's ability to inhibit reading a word in favour of identifying its colour. Methamphetamine abusers had greater difficulty with this task than non-users, and they also had reduced activity in the frontal lobes, likely because of the damage described previously.
- Changes in brain structure have also been noted in chronic users of **ecstasy/3,4-methylenedioxy-N-methylamphetamine/MDMA**, a drug that is typically classified as a stimulant, but also has hallucinogenic effects. Ecstasy exerts its influence on the brain by stimulating the release of massive amounts of the neurotransmitter serotonin; it also blocks its reuptake, thereby ensuring that neurons containing serotonin receptors will fire at levels much greater than normal. Ecstasy heightens physical sensations and is known to increase social bonding and compassion among those who are under its influence. Unfortunately, this drug has also been linked to a number of preventable deaths. Heat stroke and dehydration are major risks associated with ecstasy use, especially when the drug is taken at a rave where there is a high level of physical exertion from dancing in an overheated environment. It can also lead to lowered mood two to five days after consumption, as it takes time for serotonin levels to return to normal. Several studies have shown that MDMA impairs the sensitivity of many visual regions in the occipital lobe. Additionally, recent neuroimaging data show that using ecstasy can produce unique damage (independent of the effects of other drugs) in several areas of the cortex in the left hemisphere. Given that the left hemisphere is also critical for language abilities, it should come as no surprise that ecstasy users show slight impairments on language-based tests of memory.
- **Hallucinogens:**
- **Hallucinogenic drugs** are substances that produce perceptual distortions.
- Depending on the type of hallucinogen consumed, these distortions may be visual, auditory, and sometimes tactile in nature, such as the experience of

crawling sensations against the skin. Hallucinogens also alter how people perceive their own thinking.

- One commonly used hallucinogen is LSD, which is a synthetic drug. A recent study examined brain activity of individuals after they had just taken LSD. These researchers found that the LSD experience involves greater activity in visual areas; this activity strongly correlated with participants' reports of hallucinations. The researchers also noted reduced connectivity between areas in the temporal and parietal lobe; these changes were related to feelings of "losing oneself" and finding "altered meanings." These results show the strong link between brain activity and moment-to-moment experiences.
- Hallucinogenic substances also occur in nature, such as psilocybin (a mushroom) and mescaline (derived from the peyote cactus). Hallucinogens can have very long-lasting effects. LSD can last for more than 12 hours. These drugs may also elicit powerful emotional experiences that range from extreme euphoria to fear, panic, and paranoia. The two most common hallucinogens, LSD and psilocybin, both act on the transmission of serotonin.
- Short-acting hallucinogens have become increasingly popular for recreational use. The effects of two of these hallucinogens, ketamine and DMT (dimethyltryptamine), last for about an hour. Ketamine was originally developed as a surgical anesthetic to be used in cases where a gaseous anesthetic could not be applied, such as on the battlefield. Ketamine induces dream-like states, memory loss, dizziness, confusion, and a distorted sense of body ownership. This synthetic drug blocks receptors for glutamate, which is an excitatory neurotransmitter that is important for, among other things, memory.
- The short-acting hallucinogen known as DMT occurs naturally in such different places as the bark from trees native to Central and South America and on the skin surface of certain toads. DMT is even found in very small, naturally produced amounts in the human nervous system. The function of DMT in the brain remains unclear, although some researchers have speculated that it plays a role in sleep and dreaming, and even out-of-body experiences. DMT is used in Canada primarily for recreational purposes. Users frequently report having intense "spiritual" experiences, such as feeling connected to or communicating with divine beings (as well as aliens, plant spirits, and other beings that aren't part of most modern people's version of reality). In fact, its ability to apparently enhance spiritual experiences has been well known in South American indigenous cultures. DMT is the primary psychoactive ingredient in **ayahuasca**, which plays a central role in shamanistic rituals involving contact with the spirit world. An increasing number of Canadians have used another drug, **salvia divinorum**, for similar purposes.
- Salvia divinorum is an herb that grows in Central and South America. When smoked or chewed, salvia induces highly intense but short-lived hallucinations. Use of this drug also leads to **dissociative experiences**, a detachment between self and body.
- Many psychedelics can have serious negative consequences on users, ranging from memory problems to unwanted "flashbacks" in which the user

re-experiences the visual distortions and emotional changes associated with the psychedelic state. However, some psychedelics are now being used to treat a number of clinical conditions. LSD has been used to help people deal with the anxiety associated with terminal illnesses. Psilocybin (magic mushrooms), ayahuasca, and DMT have all been used to help reduce addiction to tobacco and alcohol. MDMA (ecstasy) has been used to help people suffering from post-traumatic stress disorder or PTSD.

- **Marijuana:**
- **Marijuana** is a drug comprising of the leaves and buds of the Cannabis plant that produces a combination of hallucinogenic, stimulant, and relaxing (narcotic) effects. These buds contain a high concentration of a compound called tetrahydrocannabinol (THC). THC mimics **anandamide**, a chemical that occurs naturally in the brain and the peripheral nerves. Both anandamide and THC bind to cannabinoid receptors and induce feelings of euphoria, relaxation, reduced pain, and heightened and sometimes distorted sensory experiences. They also stimulate one's appetite.
- Marijuana use often starts during the teenage years. From a neurological perspective, early drug use is a particular cause for concern. The brain develops in a step-by-step fashion, with higher-order cognitive areas, particularly the frontal lobes, developing after other areas have fully matured. As part of this step-by-step development, the white-matter fibres connecting brain regions grow and form new connections while unnecessary synapses are pruned away. Marijuana use during the teenage years has been shown to impair both of these developmental processes. It has also been linked with thinning (i.e. fewer cells) in a number of cortical areas and smaller hippocampal volumes.
- These changes in the brain's development can affect cognitive abilities. Increasing evidence indicates that the effects of marijuana on memory and executive functions are much larger in people who started taking the drug before the age of 17. In other words, using marijuana during an earlier stage of development can have a much larger effect on a person's future than if the same dose were to be consumed or smoked later in life.
- It is important to note that if you did smoke marijuana before the age of 17, your life isn't ruined. It just means that if you continue to frequently use marijuana, you are statistically more likely to have memory and executive functioning problems later in life. It is quite possible that your brain will recover. You can help it bounce back by reducing your consumption of drugs and by engaging in behaviours that help increase the thickness of white-matter pathways in the frontal lobes.
- Currently, marijuana is the most commonly used recreational drug in Canada. This high usage rate reflects, in part, the fact that this drug is so readily available.
- Studies of people under the influence of marijuana have demonstrated a number of different impairments to memory processes. Several researchers have confirmed that marijuana disrupts short-term memory. Studies of long-term memory have indicated that marijuana use was associated with a reduced ability to recall information and a greater tendency to commit intrusion errors.

- Many executive functions are impaired by THC. For instance, marijuana impairs people's ability to problem solve and to change their strategies while performing a task. It may impair creative thinking and attention as well.
- Neuroimaging results indicate that the memory and cognitive difficulties experienced by people who smoke marijuana are likely related to changes in their brains.
- A number of studies have noted that reduced performance on memory tests is related to decreases in brain activity in the right frontal lobe, an area involved with memory retrieval.
- **Opiates:**
- **Opiates/narcotics** are drugs such as heroin and morphine that reduce pain and induce extremely intense feelings of euphoria.
- These drugs bind to endorphin receptors in the nervous system. Endorphins (endogenous morphine) are neurotransmitters that reduce pain and produce pleasurable sensations, whose effects are magnified by opiates.
- Naturally occurring opiates are derived from certain species of poppy plants that are primarily grown in Asia and the Middle East (particularly Afghanistan).
- Opiate drugs are very common in medical and emergency room settings. For example, the drug fentanyl is used in emergency rooms to treat people in extreme pain. A street version of fentanyl, known as "China White," can be more than 20 times the strength of more commonly sold doses of heroin. This drug is so dangerous that in April 2016, British Columbia declared a public health emergency after more than 200 people died from overdoses of the drug.
- Treating opiate addiction can be incredibly challenging. Opiates produce very rapid and powerful "highs". Because the time between injecting or smoking opiates and their physical impact is so short, it is easy for people to mentally link the drug to the pleasurable feeling. This increases the addictiveness of these drugs. People who are addicted to opiates and other highly addictive drugs enter a negative cycle of having to use these drugs simply to ward off withdrawal effects, rather than to actually achieve the sense of euphoria they may have experienced when they started using them. Methadone is an **opioid** (a synthetic opiate) that binds to opiate receptors but does not give the same kind of high that heroin does. A regimen of daily methadone treatment can help people who are addicted to opiates avoid painful withdrawal symptoms as they learn to cope without the drug.
- Another opioid, oxycodone (OxyContin), has helped many people reduce severe pain while having relatively few side effects. Unfortunately, this drug, along with a similar product, Percocet, has very high abuse potential. It is often misused, especially by those who have obtained it through illegal means.
- **Legal Drugs and Their Effects on Consciousness:**
- **Sedative drugs**, sometimes referred to as "downers," depress activity of the central nervous system.
- Barbiturates were an early form of medication used to treat anxiety and promote sleep. High doses of these drugs can shut down the brainstem regions that regulate breathing, so their medical use has largely been discontinued in favour

of safer drugs. Barbiturates have a high potential for abuse, typically by people who want to lower inhibitions, relax, and try to improve their sleep. Incidentally, while these agents may knock you out, they do not really improve the quality of sleep. Barbiturates actually reduce the amount of REM sleep.

- Newer forms of sedative drugs, called **benzodiazepines**, include prescription drugs such as Xanax, Ativan, and Valium. These drugs increase the effects of gamma-aminobutyric acid (GABA), an inhibitory neurotransmitter that helps reduce feelings of anxiety or panic. The major advantage of benzodiazepine drugs over barbiturates is that they do not specifically target the brain regions responsible for breathing and, even at high doses, are unlikely to be fatal. However, people under the influence of any kind of sedative are at greater risk for injury or death due to accidents caused by their diminished attention, reaction time, and coordination.
- **Prescription Drug Abuse:**
- Prescription drugs are commonly abused by illicit users.
- Over 15% of Canadian high school students have reported abusing prescription drugs at some point in their lives. The prevalence of prescription drug abuse becomes even more extreme when these students enter university. Surveys have shown that as many as 31% of university students sampled have abused Ritalin, the stimulant commonly prescribed as a treatment for ADHD.
- A massive number of prescription drugs are available on the market, including stimulants, opiates, and sedatives. In 2011, 3.2% of Canadians (approximately 1.1 million people) used prescription drugs for nonmedical reasons within the year prior to the survey. Users typically opt for prescription drugs as their drugs of choice because they are legal, pure, and relatively easy to get.
- Prescription drugs are typically taken at large doses, and administered in such a way as to get a quicker, more intense effect.
- Some of the most commonly abused prescription drugs in Canada are painkillers such as OxyContin. When used normally, OxyContin is a pain-reliever that slowly releases an opioid over the course of approximately 12 hours, thus making it a relatively safe product. However, crushing the OxyContin tablet frees its opioid component oxycodone from the slow-release mechanism; it can then be inhaled or dissolved in liquid and injected to provide a rapid high. Almost 80% of people entering treatment programs for OxyContin abuse admitted that the drug was not prescribed to them, suggesting that there is a flourishing trade in this drug.
- Approaches to reducing prescription drug abuse include efforts to develop pain medications that do not act on pleasure and reward centres of the brain. Furthermore, many communities offer prescription drug disposal opportunities, which helps remove unused drugs from actual or potential circulation. In addition, doctors and other health care professionals are becoming increasingly aware that some individuals seeking prescription drugs are doing so because they are addicted to them.
- **Alcohol:**
- Alcohol has a number of effects on the brain. It initially targets GABA receptors, and subsequently affects opiate and dopamine receptors. The stimulation of

opiate and dopamine receptors accounts for the euphoria associated with lower doses as well as its rewarding effects. The release of GABA, an inhibitory neurotransmitter, reduces the activity of the central nervous system, which helps explain the impairments in balance and coordination associated with consumption of alcohol. The reason that people become less inhibited when they drink is that alcohol inhibits the frontal lobes of the brain. One function of the frontal lobes is to inhibit behaviour and impulses, and alcohol appears to impair the frontal lobe's ability to do so.

- Many socially unacceptable consequences are also associated with alcohol use. Alcohol abuse has been linked to health problems, sexual and physical assault, automobile accidents, missing work or school, unplanned pregnancies, and contracting sexually transmitted diseases. These effects are primarily associated with heavy consumption, which can often lead to **alcohol myopia**. When intoxicated, people often pay more attention to cues related to their desires and impulses and less attention to cues related to inhibiting those desires. This tendency to focus on short-term rewards rather than long-term consequences is particularly noticeable in underage drinkers whose frontal lobes are not fully developed. Alcohol myopia is also more likely to occur in people with low self-esteem; these individuals may focus on their fear of social rejection and respond by engaging in risky behaviours that they feel will lead to social acceptance.

Definitions:

- **Activation–synthesis hypothesis:** Suggests that dreams arise from brain activity originating from bursts of excitatory messages from the pons, a part of the brainstem.
- **Brain death:** A condition in which the brain, specifically including the brainstem, no longer functions.
- **Circadian rhythms:** Internally driven daily cycles of approximately 24 hours affecting physiological and behavioural processes.
- **Coma:** A state marked by a complete loss of consciousness.
- **Consciousness:** A person's subjective awareness, including thoughts, perceptions, experiences of the world, and self-awareness.
- **Default mode network:** A network of brain regions including the medial prefrontal cortex, posterior cingulate gyrus, and medial and lateral regions of the parietal lobe that is most active when an individual is awake but not responding to external stimuli.
- **Déjà vu:** A distinct feeling of having seen or experienced a situation that is impossible or unlikely to have previously occurred.
- **Dependence:** A need to take a drug to ward off unpleasant physical withdrawal symptoms; often referred to as addiction.
- **Dissociation theory:** Explains hypnosis as a unique state in which consciousness is divided into two parts: a lower-level system involved with perception and movement and an "executive" system that evaluates and monitors these behaviours.

- **Ecstasy/MDMA:** A drug that is typically classified as a stimulant, but also has hallucinogenic effects.
- **Endogenous rhythms:** Biological rhythms that are generated by our body independent of external cues such as light.
- **Entrainment:** When biological rhythms become synchronized to external cues such as light, temperature, or even a clock.
- **Hallucinogenic drugs:** Substances that produce perceptual distortions.
- **Hypnosis:** A procedure of inducing a heightened state of suggestibility.
- **Insomnia:** A disorder characterized by an extreme lack of sleep.
- **Jet lag:** The discomfort a person feels when sleep cycles are out of synchronization with light and darkness.
- **Latent content:** The actual symbolic meaning of a dream built on suppressed sexual or aggressive urges.
- **Locked-in syndrome:** A disorder in which the patient is aware and awake but, because of an inability to move his or her body, appears unconscious.
- **Manifest content:** The images and storylines that we dream about.
- **Marijuana:** A drug comprising the leaves and buds of the Cannabis plant that produces a combination of hallucinogenic, stimulant, and relaxing (narcotic) effects.
- **Meditation:** Any procedure that involves a shift in consciousness to a state in which an individual is highly focused, aware, and in control of mental processes.
- **Mind-wandering:** An unintentional redirection of attention from one's current task to an unrelated train of thought.
- **Minimally conscious state (MCS):** A disordered state of consciousness marked by the ability to show some behaviours that suggest at least partial consciousness, even if on an inconsistent basis.
- **Narcolepsy:** A disorder in which a person experiences extreme daytime sleepiness and even sleep attacks.
- **Neurocognitive hypothesis of dreaming:** Prediction that dreaming is not a completely random by-product of brain stem activity but rather reflects waking preoccupations and emotional experiences.
- **Nightmares:** Particularly vivid and disturbing dreams that occur during REM sleep.
- **Night terrors:** Intense bouts of panic and arousal that awaken the individual, typically in a heightened emotional state.
- **Opiates/Narcotics:** Drugs such as heroin and morphine that reduce pain and induce extremely intense feelings of euphoria.
- **Persistent vegetative state (PVS):** State of minimal to no consciousness in which the patient's eyes may be open, and the individual will develop sleep–wake cycles without clear signs of consciousness.
- **Physical dependence:** The need to take a drug to ward off unpleasant physical withdrawal symptoms.
- **Polysomnography:** A set of objective measurements used to examine physiological variables during sleep.

- **Positive sleep state misperception:** A condition in which an individual substantially overestimates the amount of sleep the person is getting.
- **Preserve and protect hypothesis:** Suggests that two adaptive functions of sleep are preserving energy and protecting the organism from harm.
- **Problem-solving theory:** The theory that thoughts and concerns are continuous from waking to sleeping, and that dreams may function to facilitate finding solutions to problems encountered while awake.
- **Psychological dependence:** Occurs when emotional need for a drug develops without any underlying physical dependence.
- **Psychoactive drugs:** Substances that affect thinking, behaviour, perception, and emotion.
- **REM sleep:** A stage of sleep characterized by quickening brain waves, inhibited body movement, and rapid eye movements (REM).
- **REM sleep behavior disorder:** People with this condition do not show the typical restriction of movement during REM sleep; in fact, they appear to be acting out the content of their dreams.
- **Restless legs syndrome:** A persistent feeling of discomfort in the legs and the urge to continuously shift them into different positions.
- **Restore and repair hypothesis:** The idea that the body needs to restore energy levels and repair any wear and tear experienced during the day's activities.
- **Sedative drugs:** Sometimes referred to as "downers." They depress activity of the central nervous system.
- **Sleep apnea:** A disorder characterized by the temporary inability to breathe during sleep.
- **Sleep deprivation:** Occurs when an individual cannot or does not sleep.
- **Sleep displacement:** Occurs when an individual is prevented from sleeping at the normal time although she or he may be able to sleep earlier or later in the day than usual.
- **Sleep state misperception (SSM):** A condition in which a person substantially underestimates the amount of sleep she gets.
- **Social-cognitive theory:** Explains hypnosis by emphasizing the degree to which beliefs and expectations contribute to increased suggestibility.
- **Somnambulism:** A disorder that involves wandering and other activities while asleep; also known as sleepwalking.
- **Stimulants:** A category of drugs that speed up the nervous system, typically enhancing wakefulness and alertness.
- **Tolerance:** When repeated use of a drug results in a need for a higher dose to get the intended effect.