Appendix A: Transcript of the Lecture

This lecture presents the effects of psychoactive drugs on the brain and behaviour primarily we will be going over addiction which is a colloquial term used to describe substance use disorder. This disorder is characterized by the transition from occasional use the loss of Behavioral Control over seeking the drug or activity. Over the course of this lecture you'll learn about the different features of substance abuse disorder and how drugs of abuse potential affect the brain behaviour. First we will look at the brain's pleasure center and then talk about the neurocognitive mechanisms of drug action that are common to all drugs of the potential then we will talk about how the system is wired to be adaptive but how introducing psychoactive drugs to the same system can demonstrate how it is also maladaptive then we will briefly go over the different drug effects on the brain and behaviour. Finally before we summarize addiction in general we will talk about the core features of addiction: dependence withdrawal and tolerance. This image of the brain highlights the limbic system which is a complex system of nerves and networks in the brain involving several areas near the edge of or cortex concerned with instinct and mood. it controls the basic emotions fear pleasure anger and drives: hunger, sex, dominance and care of offspring. This image highlights the specific areas of the limbic system. The hypothalamus, the thalamus, the amygdala, and the hippocampus the hypothalamus is an area which is primarily associated with maintaining homeostasis that can be thought of as a physiological baseline for example your body is always attempting to maintain a baseline heart rate Blood pressure etc. The thalamus can be conceived of as the area of the brain in charge of relaying information. The amygdala is commonly known as the emotion center of the brain. The hippocampus is depicted here as being primarily responsible for

memory conversion However it's also involved in emotion memory and the autonomic nervous. There are many many different ways researchers can look at the brain here's an example of an inferior view of the brain. This would be as though you're looking up through the neck at the chin and the base of the brain now you'll see here is the cerebellum in the brain stem and the cortex is here. This is another view known as the superior view of the brain which is analogous to a bird's eye view both of these examples look at the entirety of the brain from the outside. However to look at the inside there are other views. One example we would use today is called a sagittal view. Imagine you were to make a slice from the forehead to the cape of the neck. You would get an internal side that looks like this note that it's the same side view that we were looking at on the previous slide only now it's only one half of the brain as though you were inside it. You'll see the same structures are highlighted here: the hypothalamus, the thalamus, the amygdala, and the hippocampus. If we were to look more closely we would be able to know the ventral tegmental area or VTA and the nucleus accumbens these structures are of particular importance when studying addiction that's because they make up the mesolimbic dopamine pathway. Within the brain there are various pathways between different brain structures that use neurotransmitters then signal brain this particular pathways and dopaminergic projections from the VTA to the nucleus accumbens. It proper name is the mesolimbic dopamine pathway. However it's referred to as the reward pathway. This is because it is associated with the subjective sensation of pleasure. The dopaminergic projections from the VTA to the nucleus accumbens translates to the subjective sensation of pleasure. In other words when this happens in our brains what we are feeling is reward or pleasure. The system is evolutionarily adaptive. It's meant to signal pleasure to ensure that we repeat the behaviour that a signal was

associated with. If you think about our ancestors foraging for food, when they came across that would give them energy and help them survive this reward pathway activates and it increases the likelihood that they will want to eat that food again. Thus increasing the chance of survival. Similarly two consenting adults engaging in behaviours that would sustain their species (sex) Would experience the same pleasure sensation by way of dopamine signals Within the reward pathway. Unfortunately the system becomes maladaptive when drugs take over an essentially hijacked it to reinforce the behaviour of doing drugs. In other words the system is hijacked by drugs which leads to increased drug seeking behaviour. Note that this is only one of the way drugs with abuse potential can affect the brain and result in addiction or dependence. But for now we will focus on the activity within the mesolimbic dopamine pathway or the pleasure center brain. Let's look more closely at what's going on in the nucleus accumbens. Within your brain there are several of these connections. Here we see one neuron making a connection with the other neurons. Remember that this is a very simple view and that there are hundreds of millions of these connections happening in your brain all at once here is what is known as synapse. It is the area of the terminal button or senders of information of the pre-synaptic cell that connect with the dendrites or receivers of information of the post-synaptic cell note however that the cells don't actually touch instead there is a microscopic area between the 2 that is called The synaptic cleft. Let's look more closely at that This a much closer look at the synapse. But again we have the presynaptic cell and the post-synaptic cell. This is the area of the brain sends information in form of neurotransmitters. Remember that we are looking at one synapse within the nucleus accumbens of the reward pathway. So here the neurotransmitters that are sent by the presynaptic cell are called dopamine. Dopamine is an excitatory

neurotransmitter and it is the primary neurotransmitter involved in increasing drug seeking behaviour just like other neurotransmitters dopamine has specific receptors on the post synaptic cell that are meant to receive its signal. These dopmaine receptors are protein bundles on the post synaptic cell that are specifically sensitive to dopamine. When dopamine binds to these cells like a key in a lock through biochemical changes they activate the cell and increase the likelihood that it will fire this is known as an excitatory post synaptic potential. Post-synaptic potentials can both increase or decrease the likelihood that a cell will fire an action potential. Because dopamine is an excitatory neurotransmitter it excites the post-synaptic cell and increases the likelihood of firing once the cell has been excited enough it will fire an action potential and the signal will be sent to the next cell. When dopamine binds to the receptors in the nucleus accumbens it translates to the subjective sensation of pleasure. Again, this is an adaptive process that would increase behaviours and help us survive both individually and as a species anytime we engage the behaviours that are pleasurable this cascade of neural circuitry happens. When we eat high glucose foods, when we have sex, when we shop, exercise and the list could go on . Another behaviour that signals the pleasure center is the act of taking drugs with abuse potential. In fact drugs with abuse potential or the potential to become addicted to them are defined as those whose effects on the brain result in this dopaminergic projection from the VTA to the nucleus accumbens. While pleasurable behaviours all result the activation of the reward pathway, drugs hijack system and send it into overload. Hence, the system becomes abundant with dopamine and the post synaptic cell becomes tremendously excited leading to an increased rate of firing in the nucleus accumbens this increased rate of firing results in the strengthening between the actions and the feeling of taking of pleasure again this

is why it's maladaptive that it is drugs hijack the system and put it into overload ultimately fusing the act of taking drugs with the feeling of extreme pleasure. Then drug seeking behaviour is reinforced to a degree that is hard to break. In fact most individuals cannot control these urges and this is what leads to addiction. I'd like to highlight however that drugs have many effects on the brain behaviour despite the fact that they all have this one effect in common note that when we discuss psychoactive drugs we are referring to any chemical substance that can modify mental emotional or behavioural functioning. There are 6 different drugs note that the term narcotics has different meanings within the legal system legal systems use this terminology to denote any illegal drug however for the purposes of this research on psychoactive drugs narcotics refers to any drugs that induce sleep. This can be remembered by recalling that narcos is a Latin term meaning sleep. Narcotics primarily include drugs from opiates. Heroin and morphine are two strong examples. The other classes of drugs are sedatives stimulants like coffee hallucinogens like LSD cannabis both THC and CBD and alcohol. I'm going to click this link here to show you the specific effect that drugs can have on the brain. This website is called Mouse party it's an interactive site that demonstrates different drug effects in the brain. So now I'll click play Here we can see a bunch of mice and we can drag them into the chair to see what effects the different drugs have. Like this one. It's the cocaine mouse. So we can see what happens in the brain when cocaine is introduced. Dopamine transporters are responsible for removing dopamine molecules from the synaptic cleft and after they have done their job. Cocaine blocks these transporters leaving dopamine trapped in the synaptic cleft. As a result dopamine binds again and again to the receptors overstimulating the cell. Like other drugs cocaine concentrates in the reward pathway However it is also active in the part of the brain

controlling voluntary movements This is why cocaine abusers are fidgety and unable to be still. Let's try one more. We will see that alcohol does. Inhibitory neurotransmitters called GABA are active throughout the brain these neurotransmitters act to control neural activity along many brain pathways when GABA binds to its receptor the cell is less likely to fire. Meanwhile in another area of the brain another neurotransmitter called glutamate acts as the brain's general purpose excitatory neurotransmitter. When alcohol enters the brain it delivers a double sedative punch. First it interacts with GABA receptors to make them even more inhibatory. Second it binds to glutamate receptors preventing the glutamate from exciting the cell. Alcohol particularly affects areas of the brain involved in memory formation decision making an impulse control. So I'm going to close this now. But if it interests you I would highly recommend playing around with it on your own. As you've seen, different drugs have different effects on the brain behaviour however all drugs with abuse potential act on the mesolimbic dopamine pathway to reinforce drug seeking behaviour. Even though there is no agreed upon definition of addiction. In fact those who struggle with addiction in colloquial terms are never actually diagnosed with addiction instead the terminology used within the DSM the Diagnostic Statistical Manual is substance to use disorder this is characterized by the transition from occasional use to the loss of behavioural control over seeking the drug or activity in other words people become dependent on a drug like cocaine or an activity like gambling you see a lot of papers and textbooks that make a distinction between physical dependence and psychological dependence I'd like to point out that this is dangerous terminology because it implies a dissociation between the two. This distinction is essentially useless because there is no psychology without physiology and vice versa. Importantly dependence has three core features they are withdraw tolerance

and reward seeking behaviour. We've talked about reward seeking behaviour by discussing the activity within the mesolimbic dopamine pathway and how it translates to the subject sensation of pleasure. This ultimately is to the increased reward signal behaviour by virtue of seeking out more drugs. Now we will take some time to go over withdrawal and tolerance before wrapping up. For many people when they think about drug withdrawal the picture a heroin addict with cold sweats and flu like symptoms. While this is wrong it is merely the depiction of withdrawal from one drug. All drugs have different withdrawal symptoms the reason for this is that withdrawal symptoms are the exact opposite of the effects of the drug. Remember that the hypothalamus is primarily responsible for maintaining homeostasis that is the logical baseline? Well drugs are introduced into the system and they disrupt homeostasis with their individual drug effects. For instance, alcohol is an anxiolytic. What that means is that alcohol as a drug reduces the sensation of anxiety your body is meant to maintain a baseline physiology even anxiety so when the levels drop down because of alcohol intake your hypothalamus tries to increase it to bring it back to baseline. Withdrawal refers to the symptoms that present after the cessation of drug use. Once the drug in this case alcohol stops having its effect on the body in this case anxiety, there is a lag between this and the hypothalamus realizing that there is no more need to counteract the effect or increase anxiety levels. What this translates to is the feeling of the opposite of the drug in this case increased anxiety another familiar withdrawal symptom is a headache after a night of drinking although you might not have termed it a withdrawal symptom. But this is what it is. Alcohol is a vasodilator which means it dilates your blood vessels. So the opposing effect or withdrawal symptom it is constructed blood vessels, which causes you to feel like you have a headache. Finally we'll talk about tolerance which

refers to a progressive decrease in one's responsiveness to certain drug effects that is experienced after repeated exposure. While tolerance seems like a simple concept to understand it's important to note that tolerance is multifaceted. There are 2 primary reasons for this. 1st tolerance is effects specific not drug specific what this means is that it's possible to build a tolerance to one effect of the drug but not the other let's use all the hall as an example again the feeling of being drunk is known as the intoxication effects of alcohol. However other effects like cutting down anxiety and dilating blood vessels are other effects of that same drug another effect of alcohol as a drug is slowed motor responses. What this means is that the time it takes you to respond to something like say a vehicle stopping abruptly in front of you increases with more alcohol. This is one of the reasons that driving under the influence is illegal even if you don't feel drunk that is it's possible to not feel intoxicated but to still experience slowed motor responses this is because tolerance for intoxication is quicker to build than tolerance for slowed motor responses. The next reason that tolerance is multi-faceted is because there are several different kinds of tolerance. Pharmacodynamic or pharmacokinetic or metabolic and behavioural otherwise known as learned tolerance. Each of these types of tolerance is characterized by the way in which it is built for sake of brevity I won't go into detail of all of them instead I'll briefly go over behavioural otherwise known as learned tolerance. Behavioural tolerance happens when your body builds up a tolerance to an effect of drugs that are associated with external stimuli again I will use the example of alcohol. Imagine a scenario where a person frequents the same bar. At this bar this person can over time start to drink an excessive amount of alcohol and the intoxication effects seem to diminish then the same person walks into a new bar and attempts to drink the same amount. This time the person is left feeling

incredible amounts of intoxication. This happens because the body has built up a tolerance to alcohol that a specific to the frequented bar. What's going on physiologically is this: the body associates the external stimuli like the sight of a frequent car with physiological changes so in anticipation of these changes the body starts to homeostatic response of counteracting the anticipated drugs effects. So in the new situation the body does not start this anticipatory homeostatic response. Which ultimately leads to an unexpected absence of tolerance. There is so much more to the effects of drugs on the brain behaviour than this however for today remember that the mesolimbic dopamine pathway or reward pathway is your body's adaptive mechanism that is meant to ensure survival. Psychoactive drugs with abuse potential essentially hijack the system and put it into overdrive which ultimately leads to increased drug seeking behaviour this has the potential to turn into dependence with three core features: withdrawal, tolerance, and reward seeking behaviour. Finally even though all drugs of abuse have the same effect on the brain behaviour there are many other effects and after effect that differ from drug to drug. Thank you.

Appendix B: Interactive Content

[Video 1: 3:57]

Think about your own personal experience with pleasure. Then, rank order the following items by how often you would experience that "dopamine dump" in the nucleus accumbens.

Top = lots of mesolimbic dopamine pathway activity.

Bottom = not a lot of mesolimbic dopamine pathway activity.

_____ Tying shoes

_____ Running, walking, or exercising

_____ Drinking alcohol

_____ Playing games (like candy crush or Call of Duty)

_____ Eating chocolate

_____ Making the bed

Homeostasis is your body's mechanism to maintain a physiological baseline. What physiology can you think of that would need to be kept at a baseline rate? If you can think of more than one example, please feel free to write about that too!

_____

_____

_____

_____

_____

Can you think of a behaviour that would make the mesolimbic dopaminergic pathway an adaptive one? If so, please type it here:

_____

[Video 2: 4:01]

The mesolimbic dopamine pathway is also said to be maladaptive. Why is that?

_____

_____

_____

_____

_____

[Video 3: 4:30]

Try it on your own!

iframe:

<iframe id="kmsembed-1_teobbuez" width="854" height="480" src="https://learn.genetics.utah.edu/content/addiction/mouse/" class="kmsembed" allowfullscreen="" webkitallowfullscreen="" mozallowfullscreen="" allow="autoplay *;

fullscreen *; encrypted-media *" referrerpolicy="no-referrer-when-downgrade" sandbox="allow-forms allow-same-origin allow-scripts allow-top-navigation allow-pointer-lock allow-popups allow-modals allow-orientation-lock allow-popups-to-escape-sandbox allow-presentation allow-top-navigation-by-user-activation" frameborder="0" title="Kaltura Player" style="position:absolute;top:0;left:0;width:100%;height:100%"></iframe>

Do you think that it's possible to become addicted to shopping?

- ○ Definitely yes
- ○ Probably yes
- ○ Might or might not
- ○ Probably not
- ○ Definitely not

Why do you think that?

_____

Before we get into withdrawal, can you think of any withdrawal symptoms?

- 1 _____
- 2 _____
- 3 _____

[Video 4: 3:37]

Before this video, you were asked to list a few withdrawal symptoms. What differs about your understanding of withdrawal now that you've watched the video?

_____

_____

_____

_____

_____

[Video 5: 4:11]

Appendix C: Modified Engagement Scale

Strongly agree to Strongly Disagree (5pt Likert Scale)

Questions

FA.1 I lost myself in this experience.

FA.2 I was so involved in this experience that I lost track of time.

FA.3 I blocked out things around me when I was watching this lesson.

FA.4 When I was watching this lesson, I lost track of the world around me.

FA.5 The time I spent watching this lesson just slipped away.

FA.6 I was absorbed in this experience.

FA.7 During this experience I let myself go.

PU.1 I felt frustrated while watching this lesson.

PU.2 I found this lesson confusing to watch.

PU.3 I felt annoyed while watching this lesson.

PU.4 I felt discouraged while watching this lesson.

PU.5 Watching this lesson was taxing

PU.6 This experience was demanding.

PU.7 I felt in control while watching this lesson.

PU.8 I could not do some of the things I needed to do while watching this lesson.

AE.1 This lesson was attractive

AE.2 This lesson was aesthetically appealing

AE.3 I liked the graphics and images of this lesson.

AE.4 This lesson appealed to be visual senses.

AE.5 The screen layout of this lesson was visually pleasing.

RW.1 Watching this lesson was worthwhile

RW.2 I consider my experience a success.

RW.3 This experience did not work out the way I had planned.

RW.4 My experience was rewarding.

RW.5 I would recommend this lesson to my family and friends

RW.6 I continued to use this lesson out of curiosity.

RW.7 The content of this lesson incited my curiosity.

RW.8 I was really drawn into this experience.

RW.9 I felt involved in this experience.

RW.10 This experience was fun.

Appendix D: Online Learning Experience Survey

1. How many courses have you taken online?
    a. If 0, skip to end.

Strongly agree to Strongly Disagree (5pt Likert Scale)

2. I enjoy learning online.
3. I have adapted well to learning online.
4. I would rather take part in face-to-face courses.
5. If it were up to me, I would take all my courses online.
6. The majority of my online courses have been synchronous.
7. I lack the self-regulatory skills needed to succeed in online learning.
8. I appreciate the freedom that online learning provides.
9. I can better manage my time when taking online courses.
10. I find myself more productive thanks to online learning.
11. I know my instructor can see my performance, even though we're online.

Please rate the following based on how satisfied you've been with each of these experiences related to online learning:

Extremely satisfied to Extremely dissatisfied

12. Video quality
13. Audio quality
14. Instructor's ability to use technology to teach online
15. Presentation quality
16. Level of understanding
17. Level of engagement
18. Access to internet
19. Access to a learning space

Appendix E: Question Bank for Retention Test

Q18 Which of the following is the correct terminology for the view of the brain that would allow a researcher to look at the inside of the brain from the side?

- ○ Sagittal View (1)
- ○ Inferior View (2)
- ○ Superior View (3)
- ○ Limbic View (4)

Q20 Which of the following is sometimes referred to as the reward pathway?

- ○ The Mesolimbic Dopamine Pathway, which connects the ventral tegmental area in the midbrain to the nucleus accumbens within the ventral striatum in the basal ganglia. (1)
- ○ The Mesolimbic Dopamine Pathway, which sends dopaminergic signals from the ventral tegmental area in the forebrain to the limbic regions within the edge of the cortex. (2)
- ○ The Tuberoinfundibular pathway, which connects the ventral tegmental area in the midbrain to the nucleus accumbens within the ventral striatum in the basal ganglia. (3)
- ○ The Tuberoinfundibular pathway, which sends dopaminergic signals from the ventral tegmental area in the forebrain to the limbic regions within the edge of the cortex. (4)

Q22 Which of the following is the term to describe a junction between two nerve cells, consisting of a minute gap across which impulses pass by diffusion of a neurotransmitter?

- ○ The synapse (1)
- ○ The axon (2)
- ○ An action potential (3)
- ○ The neural junction (4)

Q24 What would dopamine bind to in order to increase the likelihood that the post-synaptic cell will fire?

- ○ Dopamine receptors on the post-synaptic cell. (1)

○ Dopamine channels on the post-synaptic cell. (2)

○ Dopamine receptors on the pre-synaptic cell that. (3)

○ Ion channels on the pre-synaptic cell that. (4)

Q26 Which of the following is the best definition of psychoactive drugs?

○ A foreign material that enters the body and alters its function in ways that change one's physical, emotional, and mental behaviours. (1)

○ A pathogen that enters the body and alters its function in ways that increase one's physical, emotional, and mental functioning. (2)

○ A foreign material that enters the body and alters its function in ways that increase one's physical, emotional, and mental functioning. (3)

○ A pathogen that enters the body and alters its function in ways that change one's behaviours. (4)

Q28 Which of the following statements best describes drug withdrawal?

○ The result of the body's need to maintain homeostasis after the drug has been removed from the system (1)

○ A bevy of symptoms that addicts experience when they are seeking their next "fix". (2)

○ The symptomology associated with drug-seeking behaviour for those diagnosed with substance use disorder. (3)

○ The act of taking drugs away from an addict. (4)

Q30 The necessity to increase drug dosage in an attempt to exhibit previously encountered drug effects is known as:

○ Drug tolerance (1)

○ Drug withdrawal (2)

○ Drug-seeking behaviour (3)

○ Homeostasis (4)

Q32 Which of the following is the best definition of addiction?

○ The fact or condition of being addicted to a particular substance, thing, or activity. (1)

○ A colloquial term used to describe substance use disorder, which is the transition from occasional use to the loss of behavioural control over seeking the drug or activity. (2)

○ The increased need for a substance, thing, or activity that happens after repeated use and abuse. (3)

○ A colloquial term used to describe substance use disorder, which is the increased liking of a drug after chronic use and abuse that results in the inability to cease drug-taking behaviour. (4)

Q34 Ben has described himself as “unable to control the urge to do cocaine”. Which of the following neurotransmitters are likely involved in Ben’s addiction to cocaine?

○ Dopamine (1)

○ Norepinephrine (2)

○ Epinephrine (3)

○ Serotonin (4)

Q36 Which of the following brain areas is primarily responsible for ensuring that the body’s physiology does not change drastically?

○ Hypothalamus (1)

○ Thalamus (2)

○ Amygdala (3)

○ Hippocampus (4)

Q38 Which of the following brain areas would be the first place that visual information from your retina goes before travelling to your primary visual cortex?

- Hypothalamus (1)
- Thalamus (2)
- Amygdala (3)
- Hippocampus (4)

Q40 The _____ is an area in the brain primarily responsible for emotion, while the _____ is involved in memory conversion.

- Amygdala; hippocampus (1)
- Hippocampus; amygdala (2)
- Amygdala; thalamus (3)
- Hippocampus; hypothalamus (4)

Q42 The dopaminergic projections from the ventral tegmental area to the nucleus accumbens, within the limbic system results in:

- An increased risk of addiction. (1)
- The subjective sensation of pleasure. (2)
- An increased liking of a drug or activity. (3)
- The perception of pleasure. (4)

Q44 When dopamine binds to its receptors it _____ the likelihood that the cell will fire through _____.

- Increases; post-synaptic potentials (1)
- Increases; action potentials (2)
- Decreases; post-synaptic potentials (3)
- Decreases; action potentials (4)

Q46 Which of the following is not a superordinate category of psychoactive drug?

- ○ Opiates (1)
- ○ Narcotics (2)
- ○ Sedatives (3)
- ○ Stimulants (4)

Q48 Which of the following drug effects is common amongst all drugs with abuse potential?

- ○ The increase in dopamine activity within the reward pathway. (1)
- ○ The decreased rate of dopaminergic firing in the amygdala within the mesolimbic dopaminergic pathway. (2)
- ○ Increased heart rate with recreational use and decreased heart rate with chronic use. (3)
- ○ A loss of synaptic connections within areas of the brain associated with short-term memory. (4)

Q50 Tony hurt herself at work 6 months ago and her doctor prescribed her morphine, which she has been taking often to relieve the pain. Recently, her doctor increased Tony's morphine dosage because the current dosage was not relieving the pain anymore. Tony has flu-like symptoms each time she stops taking the morphine for a prolonged period of time. However, she's willing to deal with those symptoms and only takes the medication when the pain is unbearable. Does Tony meet the core features of dependence?

- ○ No. (1)
- ○ Yes. (2)

Q52 Once dopamine has done its job in the synapse, _____ on the _____ are responsible for removing them from the junction.

- ○ Dopamine transporters; pre-synaptic cell (1)
- ○ Dopamine transporters; post-synaptic cell (2)
- ○ Dopamine receptors; pre-synaptic cell (3)

- Dopamine receptors; post-synaptic cell (4)

Q54 Jeremy comes into a bar and seems to be unable to stop moving. If we knew that Jeremy had taken drugs, which of the following did he most likely take?

- Cocaine (1)
- Alcohol (2)
- Heroin (3)
- MDMA (4)

Q56 Which of the following neurotransmitters would most likely create an inhibitory post-synaptic potential?

- GABA (1)
- Dopamine (2)
- Norepinephrine (3)
- Glutamate (4)

Q58 Harry has a hard time making decisions and is pretty forgetful. In fact, his wife is often upset when she asks him to remember to stop at the store after work and he forgets. More than that, he is always buying useless things from his co-worker, who also works for a pyramid scheme. If we knew Harry was taking drugs, which of the following is he most likely taking?

- Alcohol (1)
- Cocaine (2)
- Heroin (3)
- MDMA (4)

Q60 The neural circuity involved in the development of addiction is said to be evolutionarily adaptive because…

- Pleasure sensation helps to reinforce behaviour. (1)

○ The perception of pleasure helps to reinforce behaviour. (2)

○ It strengthens one's ability to learn drug-avoidance behaviours. (3)

○ It weakens drug-seeking behaviour. (4)

Q62 When drugs with abuse potential are introduced to the system, the dopaminergic projections within the mesolimbic dopamine pathway is said to be maladaptive. Why?

○ Psychoactive drugs "hijack" the reward system and send it into overdrive leaving an abundance of dopamine in the synaptic cleft for receptor binding. This increases the rate of cell firing and therefore strengthens the association between drug and pleasure. This results in increased drug-seeking behaviour. (1)

○ Psychoactive drugs "hijack" the reward system by blocking the dopamine receptors on the post-synaptic cell. This leaves more dopamine in the synaptic cleft, which translates to the subjective sensation of pleasure, thus resulting in increased liking of the drug. (2)

○ Psychoactive drugs "hijack" the reward system and send it into overdrive leaving by blocking glutaminergic receptors on post-synaptic cells. This results in a decreased rate of firing of glutaminergic neurons, which translates to an increased liking of a drug. (3)

○ Psychoactive drugs "hijack" the reward system by increasing the production of dopamine within the neuron. This results in more dopamine available to enter the synapse, thus, increasing drug-seeking behaviour through Hebbian associative learning. (4)

Q64 Why is the differentiation between physical and psychological dependence useless or dangerous?

○ The brain and mind are not two separate entities and can only exist together. (1)

○ Physiological effects are associated with drug dependence exclusively. (2)

○ Psychological effects are not associated with drug dependence. (3)

○ Physiological effects are primarily associated with drug-seeking behaviour but psychological effects are the root of dependence. (4)

Q66 Which of the following is a common withdrawal symptom?

○ The hangover experienced after a night of drinking. (1)

- ○ Increased heart rate after excessive use of cocaine. (2)
- ○ Flu-like symptoms after the removal of methamphetamine from the system. (3)
- ○ Constipation when heroin leaves the system. (4)

Q68 Alcohol, as a psychoactive drug, is considered a sedative. In fact, when it enters the brain, there are two mechanisms of action that make alcohol a sedative. What are those two mechanisms?

- ○ Through interaction effects, alcohol increases the inhibitory effects of inhibitory neurotransmitters and it blocks excitatory receptors, ultimately preventing the excitatory neurotransmitters from binding to the cell. (1)
- ○ Over time, people build tolerance to the first effect of alcohol. However, another effect is introduced to overcome tolerance. (2)
- ○ Alcohol interacts with excitatory neurotransmitters to make them more excitatory and in binds to inhibitory receptors blocking inhibitory neurotransmitters to bind to the cell. (3)
- ○ Over time, people become sensitized to the intoxication effects of alcohol. Therefore, they need twice as much alcohol to become intoxicated. (4)

Q70 One of the side-effects of opiates is constipation. Which of the following is one of the acute withdrawal symptoms associated with opiates?

- ○ Diarrhea (1)
- ○ Constipation (2)
- ○ Increased metabolism (3)
- ○ Lethargy (4)

Q72 Lorazepam is an anxiolytic drug often prescribed to patients who suffer from anxiety attacks. It's possible that to build a tolerance to the effects of a drug that transfers to other drugs. This is called cross-tolerance. Which of the following drugs would someone build a cross-tolerance to if they were becoming tolerant to Lorazepam?

- ○ Alcohol (1)
- ○ Opiates (2)

○ Ativan (3)

○ THC (4)

Q74 Michael goes to the James Street Pub every night after work. At first, Michael would stay for 1-2 beer. Over time, Michael has been staying for more and more beer. Now, much to his partner's dismay, Michael stays for about 7-8 pints and usually has some appetizers too. Michael reports not feeling as drunk as he used to with that many beers. He says he has built a tolerance. One day, Michael goes to a different pub with his partner and drinks 6 beer. He finds himself highly intoxicated and later on throws up. Which of the following is the best explanation of why this happened even after Michael built a tolerance to beer?

○ His body built a learned tolerance to the James Street Pub that did not transfer to the new pub. (1)

○ The beer at the new pub is different than the beer at James Street Pub. (2)

○ Usually Michael gets food at James Street Pub. He must not have eaten enough that day. (3)

○ Being with his partner made him nervous and this state increases the likelihood of increased intoxication. (4)

Q76 Which of the following statements is true about the limbic system?

○ It is sometimes referred to as the addiction pathway. (1)

○ It comprises several brain areas and is primarily responsible for instinct and mood. (2)

○ It is a complex system of neurons within the mid-brain that controls procedural memory and implicit motor responses. (3)

○ It is located at the base of the foot and that's way people can sometimes be addicted to tying their shoes. (4)

○