



# Addiction

*Jim Zhao 2023II06*

# SYLLABUS

## 1. DEFINITIONS

## 2. PHYSIOLOGICAL MECHANISMS OF ADDICTION

## 3. COMMON DRUGS, DISORDERS AND TREATMENTS

\* **ALCOHOL** (酒精)

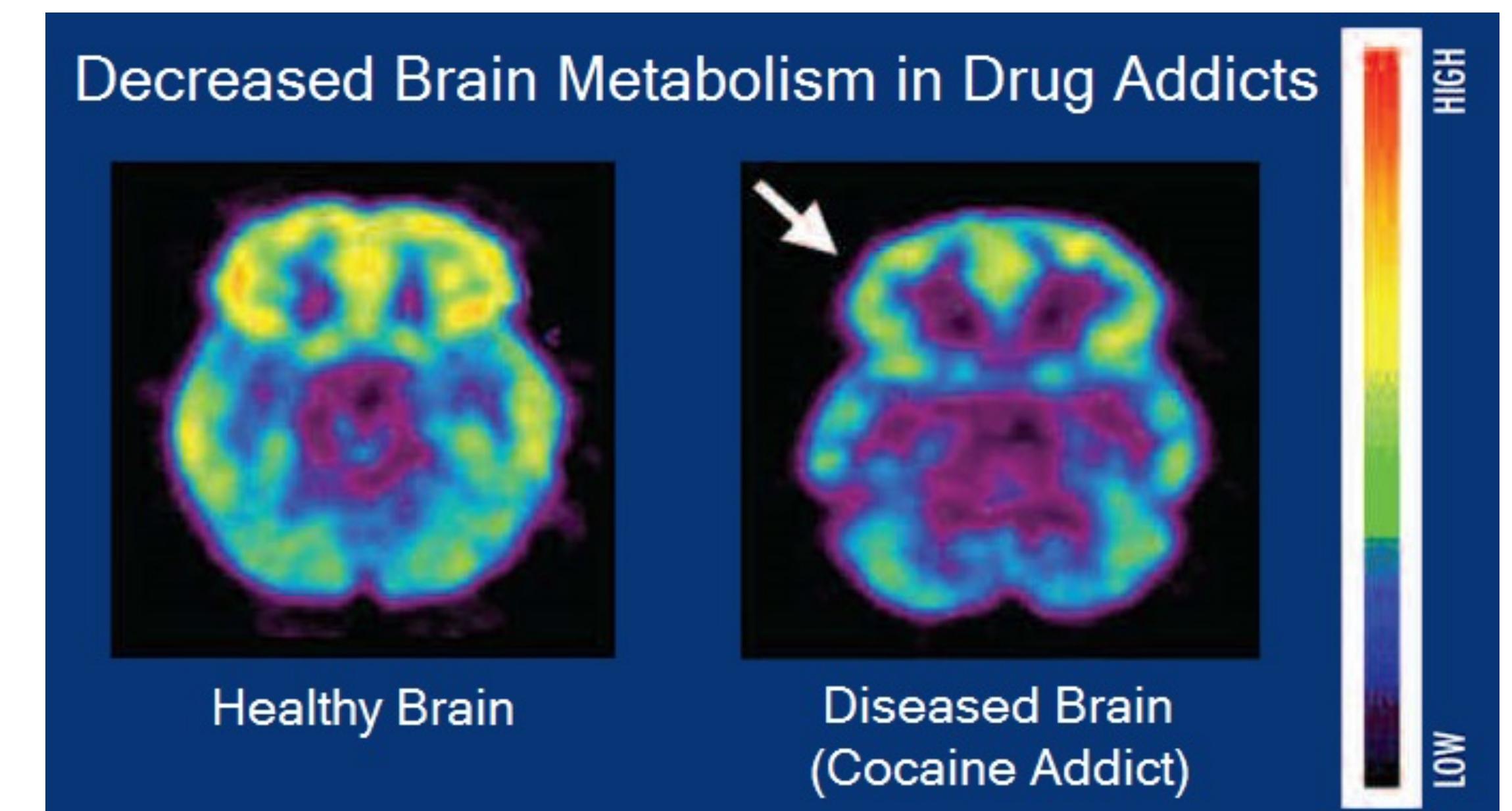
\* **NICOTINE** (尼古丁)

\* **MARIJUANA** (大麻)

\* **OPIATES** (鸦片)

\* **PSYCHOSTIMULANTS** (兴奋剂)

\* **HALLUCINOGEN** (致幻剂)



# DEFINITION

## DEFINITION OF ADDICTION

**Addiction:** A chronic brain disorder that affects the body through physical and psychological dependence.

- Behavioural addiction (natural rewards)
- Drug addiction

Regular use of substances like opioids, alcohol, tobacco or other drugs becomes an addiction when a person **can no longer control his or her use** despite **negative consequences such as loss of control and harm to themselves or others**.

# **PHYSIOLOGICAL MECHANISMS**

## **2 STAGES OF ADDICTION**

### **Positive: reward sensitisation**

When a person's body becomes used to a drug and requires more of it to experience the same effects, such as pleasurable feelings.

### **Negative: avoiding withdrawal**

When lack of a drug causes the body to react with unpleasant or life-threatening physical symptoms. (Body aches, anxiety, irritability, intense cravings for the substance, nausea, hallucinations, headaches, cold sweats, tremors, and seizures.)

# PHYSIOLOGICAL MECHANISMS

## REWARD SYSTEM

"Almost all abused drugs produce **pleasure** by activating a specific circuit of neurones, the brain's **reward system**, which is controlled mainly by the **neurotransmitter dopamine**."

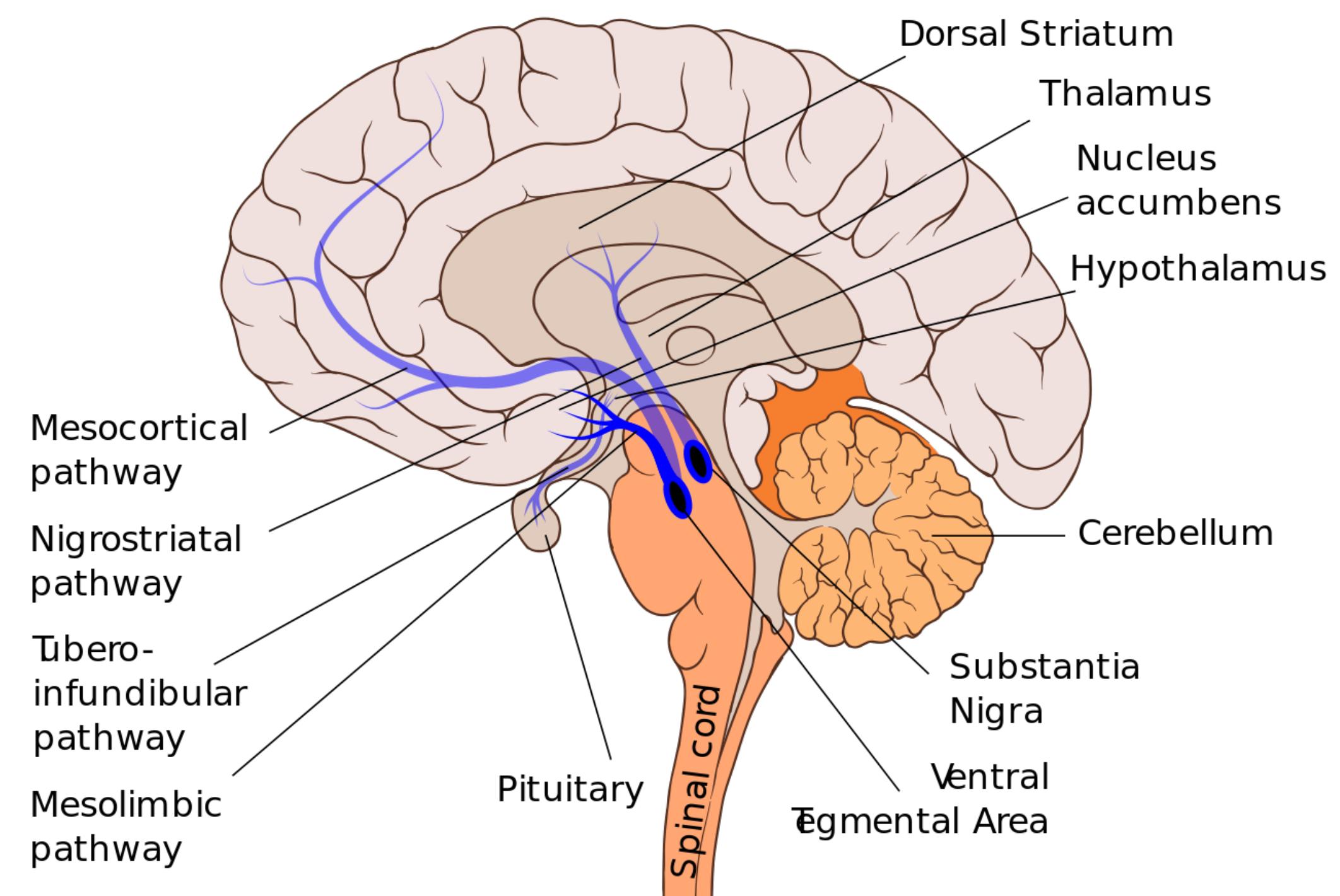
Addiction is a **disorder** of the brain's **reward system** which arises through **transcriptional** and **epigenetic** mechanisms and develops over time from **chronically high levels of exposure** to an **addictive stimulus** (e.g. eating food, the use of cocaine, engagement in sexual activity, participation in high-thrill cultural activities such as gambling, etc.)

# PHYSIOLOGICAL MECHANISMS

## \*REWARD SYSTEM: THE MESOCORTICOLIMBIC (MESOLIMBIC) PATHWAY

A pathway that connects the VTA in the midbrain to the VS of the basal ganglia in the forebrain.

- **VTA:** ventral tegmental area
- **NAc:** nucleus accumbens (pleasure centre)  
(VS: ventral striatum)
- <https://www.youtube.com/watch?v=7VUIKP4LDyQ>



# **PHYSIOLOGICAL MECHANISMS**

## **ENVIRONMENTAL FACTORS**

Even in individuals with a relatively low genetic risk, exposure to sufficiently high doses of an addictive drug for a long period of time (e.g., weeks–months) can result in an addiction.

- Age
- Comorbid psychiatric disorders

# PHYSIOLOGICAL MECHANISMS

## GENETIC & EPIGENETIC FACTORS

**Genetic:** genes.

- Rarely does only one twin have an addiction. In most cases where at least one twin suffered from an addiction, both did, and often to the same substance.
- Type1: affects how brain circuits respond to drugs.
- Type2: affects the way the body metabolises drugs.

**Epigenetic:** heritable phenotype changes that do not involve alterations in the DNA sequence.

- Some of the alterations to the epigenome which arise through chronic exposure to addictive stimuli during an addiction (environmental stimuli) can be transmitted across generations, in turn affecting the behaviour of one's children.

# PHYSIOLOGICAL MECHANISMS

\* **$\Delta$ FosB**: a gene transcription factor

DeltaFosB ( $\Delta$ FosB): a critical component and **common factor** in the development of virtually **all forms of behavioural and drug addictions**.

In the **nucleus accumbens**, once over-expressed,  $\Delta$ FosB functions as a "sustained molecular switch" and "master control protein" in the development of an addiction by triggering a series of transcription events that induces neuroplasticity (ability of neural networks in the brain to change through growth and reorganisation). It ultimately produce compulsive reward-seeking stage.

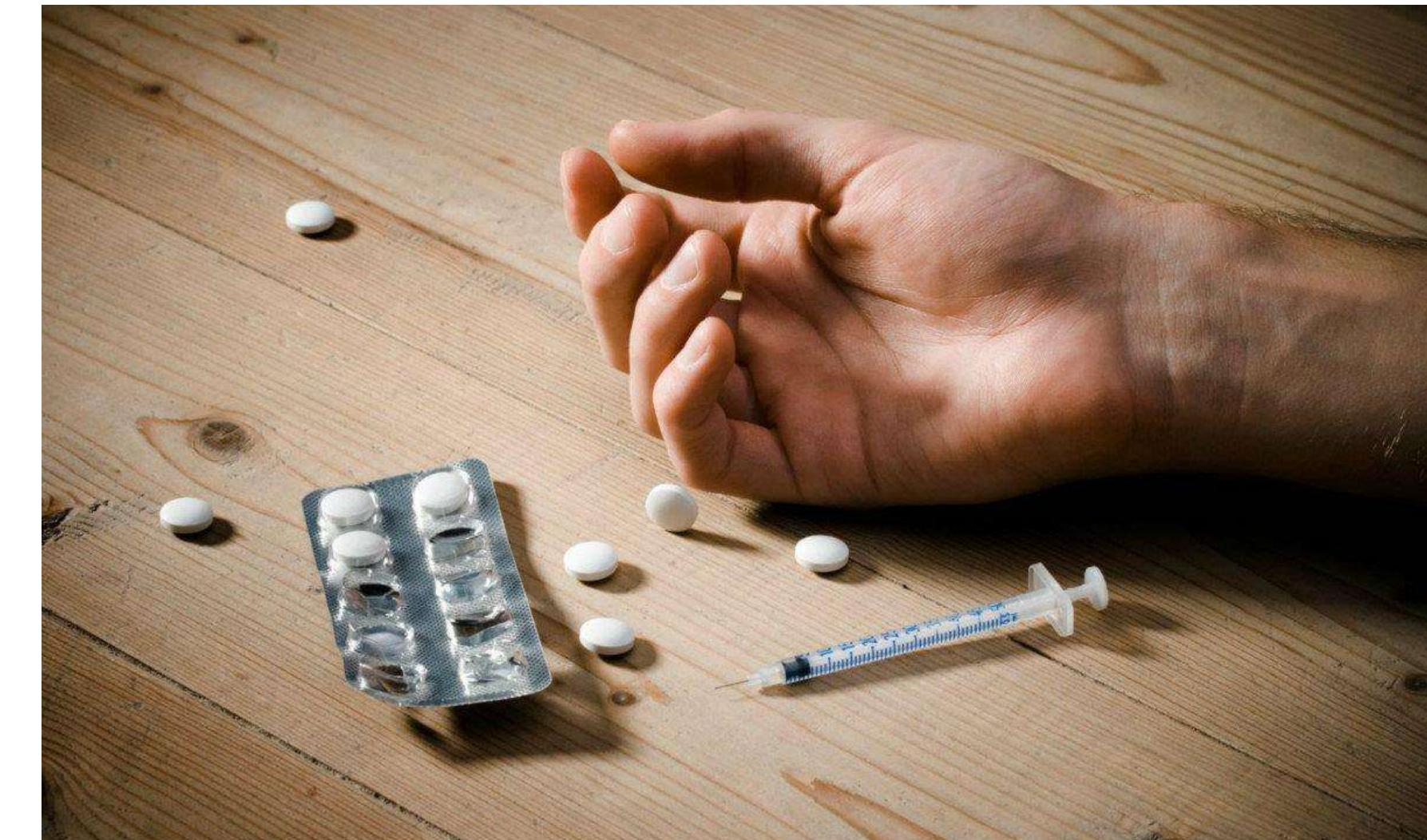
- $\Delta$ JunD, a transcription factor
- G9a, a histone methyltransferase

Both oppose the function of  $\Delta$ FosB and can reduce many of the neural and behavioural alterations that result from chronic high-dose use of addictive drugs.

# COMMON DRUGS, DISORDERS AND TREATMENTS

## COMMON FEATURE:

Activation of dopamine-producing reward pathways that induce feelings of pleasure and affect motivation, creating the urge to use more.



# COMMON DRUGS, DISORDERS AND TREATMENTS

## ALCOHOL 酒精

- drunk driving
- sexual assault
- domestic violence
- \*\*\*primary chronic health problem: **cirrhosis** 肝硬化



# COMMON DRUGS, DISORDERS AND TREATMENTS

## ALCOHOL 酒精

Ethanol is soluble, so it easily enters bloodstream and quickly travels to the brain.

1. Low [ethanol]—stimulant
2. High [ethanol]—depressant, causing intoxication, sleepiness, “blackouts”(short-term memory loss)
3. Excessive [ethanol] consumption in a short period of time—**binge drinking**, slows heart rate and causes breathing difficulties
4. Chronic, heavy [ethanol] consumption—changes brain structures:
  - damaged **cerebellum** leads to unsteady gait and slurred speech
  - degeneration of neurones in **hippocampus** leads to memory loss

# COMMON DRUGS, DISORDERS AND TREATMENTS

## ALCOHOL 酒精

### Effects

- a. Ethanol targets **gamma-aminobutyric acid (GABA) receptors** which drive the brain's **inhibitory** system.
  - calms anxiety
  - weakens muscles
  - delays reaction time
- b. Ethanol blocks **N-methyl-D-aspartate (NMDA)** type of glutamate receptors, which alter **mood** and **impair memory** (common features of intoxication).
- c. Ethanol stimulates brain's **pain-relief circuit**, fuelled by natural opioid molecules.
  - feel-good effects
  - diuretic, causing dehydration

# COMMON DRUGS, DISORDERS AND TREATMENTS

## ALCOHOL 酒精

### Treatment

#### a. Behavioural therapy

- individual counselling
- group therapy & support groups

#### b. Medication

- **disulfiram, naltrexone and acamprosate**

#### c. Genetic testing

# COMMON DRUGS, DISORDERS AND TREATMENTS

## NICOTINE尼古丁

Naturally produced in the nightshade family of plants (most notably in **tobacco**)

Within 10 seconds of smoking a cigarette, nicotine arrives in the brain.



# COMMON DRUGS, DISORDERS AND TREATMENTS

## NICOTINE尼古丁

### Effects



“Nicotine is responsible for **coronary heart disease** and **stroke**”.

- Stimulates the nervous system to reduce diameter of arterioles.
- Release hormones e.g. **adrenaline**—increase blood pressure and heart rate, (together with **dopamine**) creating pleasure and energy while decreasing blood supply to the extremities of the body. It is followed by **calming sensation** and a rapid boost in **attention** and **memory**.
- Increases the risk of blood clotting.

# COMMON DRUGS, DISORDERS AND TREATMENTS

## NICOTINE尼古丁

### Uses

- Non-addictive nicotine-like substances: possible treatments for cognitive disorders such as **schizophrenia, attention-deficit hyperactivity disorder(ADHD)** and **Alzheimer's disease**.
- **Depressive** non-smokers experience mood improvements under nicotine administration.  
(Improve sleeping quality)

# COMMON DRUGS, DISORDERS AND TREATMENTS

## NICOTINE尼古丁

### Treatment

- **Buprenorphine:** help smokers quit by simulating nicotine's effect on dopamine. (Also used to treat opioid addiction)
- **Varenicline:** nicotine mimic that attaches to a special type of nicotinic acetylcholine receptor that is thought to be responsible for conveying nicotine's addictive properties by reducing the pleasurable effects.
- (More effective when combined with counselling and behavioural therapy)

# COMMON DRUGS, DISORDERS AND TREATMENTS

## MARIJUANA 大麻

Comes from dried leaves, flowers, stems, and seeds of the *Cannabis* plant.

- Cannabidiol CBD
- Tetrahydrocannabinol THC



# COMMON DRUGS, DISORDERS AND TREATMENTS

## MARIJUANA 大麻

### Effects

- Short-term: Mind altering chemical **Tetrahydrocannabinol** (THC) distorts perception and alters a person's movement, memory, sense of time, space and self.
- Long-term: physical changes in the brain circuits of reward system, **e.g.schizophrenia**

# COMMON DRUGS, DISORDERS AND TREATMENTS

## MARIJUANA 大麻

### Uses

- a. Some people with **PTSD** (post-traumatic stress disorder) self-medicate with marijuana
  - cope with anxiety, stress and insomnia
  - erase trauma-related memories
- b. Treatment for nausea associated with chemotherapy
  - (too little evidence)

# COMMON DRUGS, DISORDERS AND TREATMENTS

## MARIJUANA 大麻

### Treatment

- **Cognitive-behavioural therapy (CBT)**: the most common form of psychotherapy used in treating behavioural addictions.
- **Contingency management**: Frequent monitoring of the target behaviour and the provision (or removal) of tangible, positive rewards when the target behaviour occurs.
- **Motivational enhancement therapy**: Produce rapid, internally motivated change; the therapy does not attempt to treat the person, but rather mobilise his or her own internal resources for change and engagement in treatment.

Currently, the FDA has not approved any medications for the treatment of marijuana use disorder.

# COMMON DRUGS, DISORDERS AND TREATMENTS

## OPIATES 鸦片类

Source: extracting **opium** (morphine) from the juice of **poppy flowers**.

- Heroin: reaches the brain in 15 to 20 seconds, then is quickly converted back into morphine which binds to opioid receptors, switching on the brain's reward system and flooding synapses with dopamine.

# **COMMON DRUGS, DISORDERS AND TREATMENTS**

## **OPIATES 鸦片类**

### **Effects**

- Intense euphoria followed by a few hours in a state of relaxed contentment.
- Shortness of breath (usual cause of death).

# COMMON DRUGS, DISORDERS AND TREATMENTS

## OPIATES 鸦片类

### Uses

- Natural opioids: **endorphins** produced by pituitary glands, which helps control motivation, emotion, food intake and our response to pain.
- Synthetic opioids: **prescription pain medicines** like codeine, oxycodone and fentanyl.
- Suppressing a cough, stopping diarrhoea.

# COMMON DRUGS, DISORDERS AND TREATMENTS

## OPIATES 鸦片类

### Treatments

- **Antidote-like approach** using synthetic drugs (e.g. naloxone) that block opioid receptors. If given quickly enough, it can reverse or prevent a potential overdose.
- **Adone** and **buprenorphine** stimulate opioid receptors but produce a limited high, and reduced withdrawal symptoms from other opioids, which deter a person from seeking abused opioids.

# **COMMON DRUGS, DISORDERS AND TREATMENTS**

## **PSYCHOSTIMULANTS**兴奋剂

Chemicals that excites the brain: giving a temporary boost to physical and/or mental function.

e.g. caffeine, nicotine, cocaine...

# COMMON DRUGS, DISORDERS AND TREATMENTS

## PSYCHOSTIMULANTS 兴奋剂

### Effects

- Short-term effect: Cocaine and methamphetamine\* produces a rush of **euphoria** and feelings of **power** and **self-confidence** by flooding the reward system with dopamine.
- Long-term effect: **free radicals** are generated which destroy dopamine neurones, so that body cannot release normal amounts of dopamine.

# COMMON DRUGS, DISORDERS AND TREATMENTS

## PSYCHOSTIMULANTS兴奋剂

### Uses

- Act in **frontal cortex** to promote arousal and quicken thinking, and help with emotional control.
- Commonly prescribed medications: **phetamine** and **methylphenidate**, treating **attention-deficit hyperactivity disorder (ADHD)** and sleep disorder **narcolepsy嗜睡症**.

# COMMON DRUGS, DISORDERS AND TREATMENTS

## PSYCHOSTIMULANTS 兴奋剂

### Treatment

- CBT
- Medication: The only functioning compounds—TAAR1, a selective agonists remains an **experimental drug**.
- new experiments focus on new target, e.g. the brain's immune cells (**microglia**) and **oxytocin**.

Consistent aerobic exercise, especially endurance exercise (e.g. marathon)

Consistent aerobic exercise magnitude-dependently (= depends on duration and intensity) reduces drug addiction risk, which appears to occur through the **reversal of drug induced addiction-related neuroplasticity**.

# COMMON DRUGS, DISORDERS AND TREATMENTS

## HALLUCINOGEN 致幻剂

1. Rohypnol 罗眠乐：

迷幻加抑制

本质：氟硝西泮（苯二氮卓类药物——GABA激动剂）

2. GHB 4-羟基丁酸

3. ketamine 氯胺酮——兽药镇定剂，有迷幻效果

ketamine对于抑郁有短期疗效

4. LSD 毒蘑菇内含有