THE HIJACKED BRAIN
Addiction is a devastating disease that alters the brain’s circuitry, notably in young adults. But the changes need not be permanent: improved understanding of them will help in developing ways to lessen the burden. By Margaret Munro. See a Nature Video at go.nature.com/1g6kk.

ADDITION CYCLE

STAGE 1: BINGE/INTOXICATION
Addiction is characterized by binging, withdrawal, cravings, dopaminergic euphoria and an inability to abstain from the substance or behaviour. It quickly leads to disruption of interconnected brain circuits that are involved in reward, learning and control.

With time, other brain areas are recruited, including those involved in stress and anxiety — in effect an ‘anti-reward’ system.

STAGE 2: WITHDRAWAL/NEGATIVE MOOD
Chronic exposure to addictive substances and behaviour reduces the number of dopamine receptors in the nucleus accumbens, so more of the addictive substance or behaviour is needed to feel normal. Changes to the amygdala (C) circuitry have been linked to the irritability, anxiety and stress associated with withdrawal.

STAGE 3: PREOCCUPATION/PREVENTION/ANTICIPATION
People with dependencies have compulsive cravings to repeat the addictive behaviour. Drug misuse is thought to alter the function of the frontal cortex (D) and the hippocampus (E) and helps to embed desires even if they have negative consequences.

THE DOPAMINE CONNECTION

Many drugs inhibit natural neurotransmitters to result, directly or indirectly, in an increase in dopamine. Dopamine is involved in regulating feelings such as pleasure and in activities that include movement and learning. The most well-described interactions are shown here, but there are other putative routes.

THE high COST OF A HABIT

The estimated annual cost of health care associated with substance misuse in the United States.

TOBACCO

US$130 BILLION

ALCOHOL

US$25 BILLION

1 BILLION
or more people smoke, with the majority living in low- to middle-income countries.

27 MILLION
people had problematic drug use2 in 2012.

38.3%
of the global population drinks alcohol, with an annual average of 12 litres per person.

5 MILLION
smokers die every year; more than 5 million of the deaths are directly related to tobacco use.

$3 MILLION
deaths in 2012 were attributed to alcohol consumption4.