Communicator Express
cross cultural communication systems, inc.
September 2011

Addiction and the Brain

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Introduction to Neuroscience

Usage of psychoactive substances, such as alcohol and opium stretches far back into human history—as does addiction. The psychological and scientific communities have long struggled with defining addiction compared with dependence. The negative stigma attached to the term addiction has prompted the most resent addition of the acronym DSM to use the terms substance dependence and substance abuse. This paper will focus on substance dependence or addiction, which is defined by the DSM as manifesting in at least three of the following ways: tolerance, withdrawal, large intake and concentration of substance, unsuccessful efforts to cut down or control, large amount of energy devoted to obtaining the substance, negative social impacts and continued usage with the knowledge of negative impacts (Seligman, P., Seligman M., Walker, Rosenhan, 2001).

All psychoactive drugs alter brain function. However, some psychoactive drugs in particular elicit addiction. For the most part these are drugs that act upon dopamine (Seligman et al., 2001). These substances tap into a key survival brain system, co-opting it towards drug-seeking behavior. However, it still remains a mystery what factors delineate social drinkers from alcoholics or recreational drug users from addicts. There are a myriad of factors that influence predisposition for addiction, which may include complex combinations of genetic and environmental factors.

The Motivational Reward Pathway

The reward pathway, previously known as the pleasure center, is one of the oldest areas of the brain (Powledge, 1999). It generates and regulates many of our basic functions and unconscious emotional reactions (Powledge, 1999). The reward pathway is an adaptive mechanism that reinforces beneficial behaviors. Water, food, and sex are all naturally occurring dopamine reinforced behaviors. However, when this adaptive response is manufactured by a drug or extreme behavior it can create addiction.

In the last fifty years, a series of studies done on rats and then monkeys, demonstrated excessive electrical and chemical self–stimulation when electrodes were placed in certain areas of the brain. The methodology for most of these experiments involved placing an electrode in the reward pathway regions of the rat's brain and stimulating it when the rat performed a certain action or task. The rats eventually spent all their time in a corner or pressing a lever, sometimes giving up food and water in favor of the new activity. The areas that reinforced this behavior fell along the trajectory of dopaminergic axons arising in the ventral tegmental area that were projected into the forebrain. The studies later progressed to test the self-administration of drugs abused by humans in monkeys (Seligman et al., 2001). The monkeys repeatedly administered nearly all human-abused drugs except for hallucinogens (Seligman et al., 2001). These animal experiments demonstrated that certain substances do not require a genetic or environmental predisposition for continued drug usage (Seligman et al., 2001). Similar studies indicated that dopamine inhibiting drugs also reduce self-stimulation and hence it is likely that subjects were stimulating dopamine release.

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Addiction and the Brain (CONTINUED FROM PAGE 1)

Dopamine is the neurotransmitter most associated with addiction, in terms of psycho-stimulant reward, neuroadaption and drug related learning (Di Chiara, Bassareo, Fenu, De Luca, Spina, Cadoni, Acquas, Carboni, Valentini & Lecca 2004). Dopamine in the brain is highly regulated (Powledge, 1999). Low levels of dopamine may lead to disorders such as Parkinson's disease and high levels of dopamine are thought to cause visions and euphoric experiences (Powledge, 1999). Dopamine receptors are classified into two groups: D1 and D2. Recent research has suggested that D1 and D2 are both involved in reinforcement however, D2 is implicated in stimulus "seeking" behavior and D1 in consumptive feelings (Powledge, 1999).

Most addictive drugs including alcohol, cocaine, nicotine, marijuana and heroin, increase the amount of extracellular dopamine through a variety of mechanisms (Seligman et al., 2001). For example, cocaine targets dopamine reuptake, whereas, amphetamines not only block dopamine and norepinephrine reuptake but also stimulates the release of more dopamine. Opiates such as morphine, increase dopamine through another method. Dopamine regulating neurons are studded with opiate receptors (Powledge, 1999). The flooded activation of these receptors serves to inhibit these naturally inhibitory dopamine neurons (Powledge, 1999). When tested in rat brains, all addictive drugs activated the nucleus accumbens dopamine system (Seligman et al., 2001). Most addictive behaviors also cause the immediate release of dopamine, which enforces the behavior (von Deneen & Liu, 2011).

The mesolimbic dopamine pathway or the reward pathway, encompasses the dopaminergic neurons in the ventral tegmental area (VTA) of the midbrain and their destination in the limbic forebrain, especially the nucleus accumbens (NAc) (Nestler, 2005). This pathway can be referred to as the VTA-NAc (Nestler, 2005). It begins in the midbrain's ventral tegmental area then extends to the nucleus accumbens (Powledge, 1999). Recent research has indicated that along with the VTA and the NAc other areas of the brain are involved in addiction including: the amygdala, hippocampus, hypothalamus and several regions of frontal cortex (Nestler, 2005). Some of these areas are centers for the memory system indicating that emotional memory may be crucial in addiction (Nestler, 2005).

The participation of these limbic areas in combination with glutamate-containing neuron dopamine regulation has indicated glutamate plays a role in addiction. The neurotransmitter glutamate is central to learning and is used through out the brain (Powledge,1999). Glutamate is thought to be a partial source of emotional and memory based craving creation and may account for environmental memory triggers for craving (Powledge, 1999). Current consensus emphasizes glutamate's role in overall brain plasticity. Addiction can be seen as another form of brain plasticity making glutamate an instrumental player (Powledge, 1999). Another neurotransmitter contributor to addiction is the endogenous opiates (Seligman et al., 2001). While, dopamine creates the "wanting" in addiction it does not initiate the "liking" component, which is generated by endogenous opiates (Berridge, Ho, Richard & DiFeliceantonio, 2010). These two systems often work in tandem with opiate stimulation creating pleasure and dopamine instigating feelings of "wanting" (Berridge et al., 2010). However, in examples such as nicotine addiction there is not a high opiate or "pleasure response," though there still is dopamine stimulation, which manufactures the addiction (Berridge et al. 2010). Opiates also help in mediation of stress and emotion (Seligman et al., 2001). Narcotic opiates interact with these endogenous opiate receptors and even alcohol is thought to involve the opiate system (Seligman et al., 2001).

Chronic Usage and Tolerance

Neuroadaptations are the changes in the brain, which occur after repeated drug exposure (Seligman et al. 2001). All psychoactive drugs cause some form of change in the brain (though it may be only temporary). As drug usage increases so does tolerance and larger doses are consumed to reach the same "high" (Nestler, 2005). With long-term exposure the body has a homeostatic response (Seligman et al. 2001). Alterations take place at the molecular and cellular levels occurring in the VTA-NAc and other reward regions (Nestler, 2005). In drugs that involve dopamine this may mean that chronic usage will impair the natural dopamine system (Nestler, 2005). The baseline level of dopamine function is reduced making stimuli that would normally be rewarding less effective (Nestler, 2005). The body attempts self- corrective action to compensate for the drug (Seligman et al. 2001). In many chronic addicts there is a reduction of striatal dopamine D2 receptors (Wang, Volkow, Thanos, Joanna & Fowler, 2004). Continued usage of many drugs including alcohol, nicotine, amphetamine and cocaine may also create high rates of tyrosine hydroxylase (TH), the enzyme that limits dopamine synthesis in the VTA (Nestler, 2005).

Research on rodents and human brain imaging has demonstrated that prolonged drug exposure may cause changes in glutamatergic outputs of the prefrontal cortex, the anterior cingulated cortex and the orbitofrontal cortex frontal cortical regions (Nestler, 2005). These regions are related to executive

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Addiction and the Brain (CONTINUED FROM PAGE 2)

control, behavioral inhibition and memory and their alteration may cause increased impulsive and compulsive behavior (Nestler, 2005). There are many other complex adaptations that take place in response to chronic usage including: reduced amounts of neurofilaments in the VTA, alteration of CREB activity and possibly reduced neurogenesis (Nestler, 2005).

Adaptations in response to prolonged drug usage are the cause of withdrawal. Withdrawal is one of the major elements of addiction, not only does it help produce high relapse rates but withdrawal in the case of alcohol can even be fatal (Powledge ,1999). Symptoms of withdrawal may manifest as psychical or emotional (Powledge, 1999). Even an addict's irresistible desire for a drug can be regarded as a symptom of withdrawal (Powledge, 1999). Memory "conditioned-withdrawal" may last years, causing addicts faced with reminders to feel the physical and emotional pangs of withdrawal long after discontinued usage (Seligman et al., 2001). Several studies done on rats in the 1970s illustrated conditioned-withdrawal. Morphine was administered when the rats pushed a lever and each time the lever was pushed a buzzer played (Seligman et al., 2001). The results demonstrated that long after the morphine stopped being released the rats still pressed the lever when the buzzer played (Seligman et al., 2001). Addiction is often a life long battle due partially to its influence over our reward system, which makes it a learned adaptation.

Behavioral Addictions Compared with Drug Addiction

The brain's reward system is fundamental for survival through its reinforcement of beneficial behaviors, creating motivation for an organism to seek a given behavior (Wang et al. 2004). Many of the same areas are instrumental in behavioral addiction as in drug addiction. However, compared with drug addiction much less is known about behavioral addictions (Nestler, 2005). Behavioral addiction may include stimuli of food, sex, exercise, gambling or other behaviors (Nestler, 2005). Much of the behavioral addiction research has been on food addiction. Food and drug addictions are thought both to access the dopaminergic pathway (von Deneen & Liu, 201l). With the increasing epidemic of obesity more and more research has addressed food addictions. Our relationship to food mimics some experiential qualities of drug abuse, including: craving, withdrawal, and pleasure from food stimuli (Pelchat, 2009). However, for these same feelings of withdrawal and craving diminish after consuming a large portion of food. Food is only considered an addiction when a type of food yields negative consequences and the individual cannot discontinue usage, meaning that most healthy, normal weight people do not have food addictions (Pelchat, 2009).

As in drug addiction disorders, the obese often show a decreased sensitivity in dopamine reward-system (Pelchat,

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English Idioms Explained

Idiom	Explanation	Example
Cut from a different cloth	Different, unique	Since he was a child everyone knew that Picasso was cut from a different cloth.
You scratch my back, I'll scratch yours	You help me and I'll help you	My neighbor told me "I'll scratch your back if you'll scratch mine." So we decided that I would mow his lawn in the summer, and he would shovel my driveway in the winter.
Give me a buzz	Call me	Give me a buzz as soon as you get home from work.
Buzzed	drunk	Jose was a bit buzzed so he decided to call a taxi, rather than drive home.
To make do	To get by on, to manage or survive on	We didn't have time to go to the store before the storm hit so we had to make do with what we had in the house.

Addiction and the Brain (CONTINUED FROM PAGE 3)

2009). It is still unknown if causation is due to preexisting lowered dopamine sensitivity or if it is related to over stimulation (Pelchat, 2009). Dopamine released in the nucleus accumbens seems to create reinforcement of the feeding behavior and dopamine in the hypothalamus regulates initiation, size and length of feeding (Joranby, Pineda & Gold, 2005). As with drug addiction the endogenous opiate system is also crucial in food addiction (Pelchat, 2009). Release of these neurotransmitters in the striatal causes increased levels of dopamine, which are thought to create the rewarding properties of sweet foods (Pelchat, 2009).

An interesting illustration of the role of dopamine in addiction is the side effects of Parkinson's treatment. Parkinson's is a degenerative disease associated with the death of certain dopamine containing cells in the midbrain. A study done in the United Kingdom showed that 3.4% to 7.2% of patients taking dopamine agonist and levodopa for Parkinson's disease had pathological gambling compared to 1% within the general population (Wong & Malcolm, 2007). There was also increased risk of other compulsive behaviors including hypersexuality, shopping addiction and drug usage (Wong & Malcolm, 2007). This illustrates dopamine's function in both drug addiction as well as behavioral addictions. Behavioral addictions such as food, sex, gambling and exercise share many of the same neuropathways as addiction—most prominently the reward and motivation pathway. However, much less is known about the "behavioral addictions" than drug addiction and this area continues to be explored.

Conclusions:
Much mystery still surrounds addiction, including: predispositions and the level of usage that manifests addiction in individuals. These are tied to questions surrounding genetic factors and environmental stimuli. It is thought that interactions of many genes create a personality type more disposed towards addiction instead of one addiction gene (Seligman et al., 2001). Besides identical twin studies, it is often difficult to determine genetics from learned family behaviors (Seligman et al., 2001). Traumatic and stressful experiences may also increase risk of addiction (Seligman et al., 2001). In some cases an individual with severe depression or other mental illnesses may be self-medicating through drug usage. However, addiction to many dopamine-altering substances does not necessitate genetic or environmental predispositions (Seligman et al., 2001). Substances that increase dopamine in the reward pathway are acting upon one of our most primal behavioral promoters. The reward pathway initiates motivation for the necessities of survival. However, it can be co-opted through drug stimulation, motivating individuals towards destructive behaviors. The neuroadaptations that take place with chronic drug usage creates tolerance and withdrawal. Homeostatic alterations in the brain may diminish the amount of dopamine in the brain reducing natural dopamine stimulation. Just as we seek water and food, with the right stimulation these same forces may drive us to seek harmful behaviors.

Abbreviations

Know your Acronyms and Abbrev. Cardio	
HR	Heart rate
BP	Blood Pressure
BPM	Beats per Minute
CBC	Complete Blood Count
MI	Myocardial Infarction
RBC	Red Blood Cell
WBC	White Blood Count
WB	Whole Blood

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President's Corner

Dear interpreter:

Substance abuse is a disease which impacts not only the identified patient but every loved one in his or her family as well. Often it also affects a person's work, health, and finances. At times it may even involve the legal system. Substance abuse is an illness. One may want to check The Diagnostic and Statistical Manual of Mental Disorders (DSMIV TR), and research the criteria for different diagnoses which are based on symptoms, behaviors, medical and family history, and the ruling out of medical conditions.

As an interpreter when you hear substance abuse, what is the first impression that grabs your attention? It is not uncommon for substance abuse to be understood as a moral weakness on the part of the abuser and at the times of his/her family. Interpreters who have themselves abused substances or whose friends and family members have a history of abuse may experience issues of transference when working with substance abusers and their families. Among these are pity, anger, shame and confusion, feelings often directed at the abuser or at the therapist conducting the intervention or treatment.

SUBSTANCE ABUSE IS A DISEASE WHICH IMPACTS NOT ONLY THE IDENTIFIED PATIENT BUT EVERY LOVED ONE IN HIS OR HER FAMILY AS WELL.

Substance abuse is not limited to alcohol but any other of the following 12 substances:

- Alcohol
- Inhalants
- Amphetamines
- Nicotine
- Caffeine
- Opioids
- Cannabis
- Phencyclidine
- Cocaine
- Sedatives, Hypnotics , or Anxiolytics
- Hallucinogens
- Other or Unknown Substances

However alcohol is a legal substance in the USA for anyone over 21 years of age. According to the Center for Disease Control:

- Excessive alcohol use, either in the form of heavy drinking (drinking more than two drinks per day on average for men or more than one drink per day on average for women), or binge drinking (drinking 5 or more drinks during a single occasion for men or 4 or more drinks during a single occasion for women), can lead to increased risk of health problems such as liver disease or unintentional injuries.
- According to the Behavioral Risk Factor Surveillance System's (BRFSS) survey, more than half of the adult population of the U.S. drank alcohol in the past 30 days. Approximately 5% of the total population drank heavily, while 15% of the population binge drank.
- According to the Alcohol-Related Disease Impact (ARDI) tool, from 2001–2005, there were approximately 79,000 deaths annually attributed to excessive alcohol use. In fact, excessive alcohol use is the 3rd leading lifestyle-related cause of death for people in the United States each year.

  Copied from http://www.cdc.gov/alcohol/index.htm

This newsletter is dedicated to all the patients and families I have interpreted for. Specially to a wonderful Azorean middle aged man, father of many children, who died more than 30 years ago, during a procedure while I was the interpreter.

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President's Corner (CONTINUED FROM PAGE 5)


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He was a heavy smoker who suffered from alcoholism and diabetes. He had his feet amputated. A few months later his lower legs also had to be amputated, and soon after that he developed a bleeding ulcer. He died in the operating room while he was having an endoscopy. He was coughing blood. He looked scared. He was emaciated. He looked liked a cadaver with amputated legs. After his first surgery, while using an oxygen mask, the nurse caught him smoking.

He had told the providers he did not want to die but he was unable to stop drinking and smoking.

He was loved by his family, and was still a provider until a few months before his death. He was funny and told jokes to his family. His wife was worried about his health and his drinking but she stated that he was always kind to her.

The family could only rely on him for the income he brought home. All the other promises, such as getting back home after work and spending weekends with the family, were broken promises that the family had had to learn to live with! His older children quickly took his place in the family and that brought them a false sense of control and happiness.

He loved to carve wood and after his recovery from his first surgery he spent a whole week carving push cars and airplanes. He made one for each of his children and one for me and his provider!

As the Portuguese interpreter, I was touched by the suffering of the many family members and also by the many patients who showed up at the emergency room with broken bones, from falls at work, with missing fingers, severed by factory machines, with bruises, caused by abusive partners, with bloody heads and
severe head trauma, caused by car accidents.

I was also confused and puzzled by the level of denial as I witnessed patients who worked so hard hiding their illnesses. They would show up at the clinic, and at first impression, one could not tell if there was an issue with substance abuse. These patients showed up at our out-patient clinic, well groomed, holding down full time jobs, sometimes working two jobs, but they shared some common symptoms such as stomach ulcers, hypertension, weigh loss, loss of appetite and higher tolerance to the substances they were taking.

Over three decades ago, alcohol was the preferred substance of abuse among the Portuguese community in the Boston area. Now, the kids of those who were alcoholics seem to struggle with a dual diagnosis of alcohol abuse along with the abuse of another substance as well.

I have attended many Alcoholic Anonymous (AA) meetings, with friends and as an interpreter as well. This is a self-support group with very specific traditions and culture. If you are going to be an interpreter it is imperative that you become familiar with the thinking and the meetings. Alcoholism is an illness without a cure, but one can work through getting dry, not drinking, and reaching recovery. This is a process, sometimes with many relapses but I know friends and patients who are recovered alcoholics and they are very healthy and happy!

Zarita

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Ask Dr. Lane

What are the current recommendations for the use of Aspirin for cardiovascular disease prevention?

In 2002, the US Preventive Services Task Force suggested that all men or women, of any age, should take aspirin to prevent heart disease. In 2009, they reviewed current studies and changed their recommendations. Aspirin, like many of our drugs, is a double edged sword. On the one hand, it inhibits platelets which are blood elements that initiate a clot. When they are less "sticky," the platelets don't form clots as easily in the clogged arteries and thus myocardial infarctions from clots blocking the blood flow to the heart's muscle can be avoided. On the other hand, it can diminish the protective covering of the stomach and along with its platelet inhibiting property cash lead to gastric ulcers and gastric bleeding.

The new guidelines suggest that aspirin should be given to certain men 45 to 79 years old with elevated risk of heart disease. This risk is elevated if someone has had a prior heart attack, high cholesterol, or a long history of smoking. For women, the task force recommends aspirin if they are 55 to79 and in danger of having an ischemic stroke. The risk of stroke is assessed with having high blood pressure, diabetes, and using tobacco.

The irony here is the risk factors that lead a patient to cardiovascular disease (heart attacks and ischemic strokes) are the same risks that lead a patient to having a gastric bleed: age, high blood pressure, high cholesterol. So you don't know, for a patient at risk, whether the benefit of giving aspirin overcomes the risk of having a bleed. Certainly it is not just a bleed in the stomach that can occur but also a bleed in the brain causing a hemorrhagic stroke. So the recommendations of this task force say to give aspirin to reduce the risk, when there is a net benefit. Net benefit means that giving the medicine would prevent one disease and not cause another.

The more recent task force has found a difference in outcome between men and women. Aspirin provides differential benefits for men as compared to women. Primary prevention studies of aspirin have found the following:

Aspirin use in men

- 32% relative risk reduction for MI
- No effect on stroke or all-cause mortality

Aspirin use in women

- 17% relative risk reduction for strokes
- No effect on MI or all-cause mortality

In men, the benefit depends on the risk. Risk Factors for cardiovascular disease for men include: Age, diabetes, total cholesterol, high density lipoprotein (if low), high blood pressure and smoking. To calculate 10 year coronary artery disease risk for a man, you can go to this link for a calculator of heart attack in men: http://hp2010.nhlbihin.net/atpiii/calculator.asp.

In women, the risk for strokes are age, atrial fibrillation, coronary heart disease, left ventricular hypertrophy, high blood pressure, smoking and diabetes. To determine 10 year risk of stroke you can go to http://www.westernstroke.org for a calculator of risk.

In May of 2009, a group of European scientists studied six high quality primary prevention studies (preventing it from happening the first time) with a combined enrollment of 95,000 low to average risk people and 16 secondary prevention (preventing it from happening again) with a combined enrollment of 17,000 high –risk patients. They found that aspirin therapy reduced the risk of non fatal heart attacks by a fifth. Aspirin did not lower stroke risk in patients with no history of heart attack or stroke. Daily treatment with aspirin was associated with high risk of internal bleeding by a third in the primary prevention trials. In every 10,000 low to moderate risk patients, one extra bleeding related stroke and three extra gastrointestinal bleeds occurred. On the basis of those findings, the director of this group says, the routine use of aspirin in healthy people can not be justified.

Risk of GI bleed goes up with age. It also increases GI complications by a factor of 3-4. Prior GI ulcers, GI bleeding or GI pain also increases the risk by a factor of 203. The risk of hemorrhagic stroke in men is increased by aspirin by a factor of 1.7 but doesn't appear to cause risk in women. Then, net benefit can be assessed by weighing potential benefit against the potential harms. The 10 year MI or stroke risk varies by age because of increased harms in older age groups. If you calculated your risk with the calculators above, you can see below whether you might have a net benefit from aspirin use:

The following table provides the 10-year risk level at which the net benefit from aspirin becomes favorable.

Favorable Net Benefit from Aspirin Use

Age	10-year MI risk (men)	Age	10-year stroke risk (women)
45-59	≥ 4 %	55-59	≥ 3 %
60-69	≥ 9 %	60-69	≥ 8 %
70-79	≥ 12 %	70-79	≥ 11 %

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Ask Dr. Lane

(CONTINUED FROM PAGE 6)

The dose of aspirin for prevention is now felt to be 75-160mg. If there is any higher coronary risk, it is felt that the benefit of 75mg po of aspirin a day outweighs the harm. Aspirin should not be given to anyone who is aspirin intolerant or those at risk for gastrointestinal bleeding and bleeding related stroke.

Ultimately, aspirin "yes or no" is really not the issue. Control of the other risk factors such as high blood pressure, high blood sugar, high cholesterol can be obtained with medications which are for the most part benign, and people with a high risk should be concerned about the other meds as well.

In summary, an aspirin a day, may be helpful to prevent a heart attack in men at risk who are above the age of 45 and strokes in women at risk who are above the age of 55. For older patients, the risk of bleeds in the stomach or the head breaks the enthusiasm to treat all comers who are healthy otherwise. So aspirin is a great tool in the fight against cardiovascular disease but it's potential for harm needs to be taken into concern when making recommendations. If in doubt, speak with your primary care doctor about whether aspirin is right for you or if this double edged sword should be kept in the sheath.

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Upcoming Conferences

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Vocabulary

Amygdale – Almond shaped mass of gray matter in the anterior portion of the temporal lobe.

Computed tomography (CT or CAT scan) – Computer-enhanced x-ray study to detect internal structural abnormalities. A series of detailed pictures of areas inside the body, created by a computer linked to an x-ray machine, are taken from different angles.

Diencephalon – The posterior part of the forebrain that connects the mesencephalon with the cerebral hemispheres, encloses the third ventricle, and contains the thalamus and hypothalamus.

Dopa – An amino acid formed in the liver from tyrosine and converted to dopamine in the brain.

Dopamine – A monoamine neurotransmitter formed in the brain by the decarboxylation of dopa and essential to the normal functioning of the central nervous system.

Hippocampus – A ridge in the floor of each lateral ventricle of the brain that consists mainly of gray matter and has a central role in memory processes. It forms part of the limbic system.

Homeostasis – The ability or tendency of an organism or a cell to maintain internal equilibrium by adjusting its physiological processes.

Hypothalamus – The part of the brain below the thalamus, forming the major portion of the ventral region of the diencephalon and regulating bodily temperature and other autonomic activities.

Limbic System – A group of interconnected deep brain structures, common to all mammals and involved in olfaction, emotion, motivation, behavior, and various autonomic functions.

Magnetic Resonance Imaging (MRI) – A procedure in which a magnet linked to a computer is used to create detailed pictures of areas inside the body.

Opiate – Any of various sedative narcotics containing opium or one or more of its derivatives. It is something that dulls the senses and induces relaxation or torpor, causing dullness or apathy and inducing sleep or sedation.

Opium – A bitter strongly addictive narcotic drug prepared from the dried juice of unripe pods of the opium poppy an annual plant native to Turkey and adjacent areas.

Parkinson's Disease – A progressive nervous disease usually occurring after the age of 50, associated with the destruction of brain cells that produce dopamine and characterized by muscular tremor, slowing of movement, partial facial paralysis and weakness.

Thalamus – A large ovoid mass of grey matter situated in the posterior part of the forebrain that relays sensory impulses to the cerebral cortex.

Withdrawal – A psychological and/or physical syndrome caused by the abrupt cessation of the use of a drug in an habituated individual.

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Answers to the CCCS Crossword - September 2011

Across

1. Endoscopy
3. Ischimia
4. Therapist
6. Heart attack
8. Hallucinogen
9. Ecosystem

Down

1. Euphoria
2. Platelets
5. Caffeine
7. Binge
10. Neurogeneis

Going Green

Preserving our trees

Trees are the lungs of the world. They play a big role in our ecosystem as they absorb carbon dioxide and some other gases as well as providing shelter for birds and other animals. They are also the main product for construction and the biggest source of oxygen for our planet, but these majestic beings are vanishing at a rapid pace as the human population is growing and the need for space is increasing.

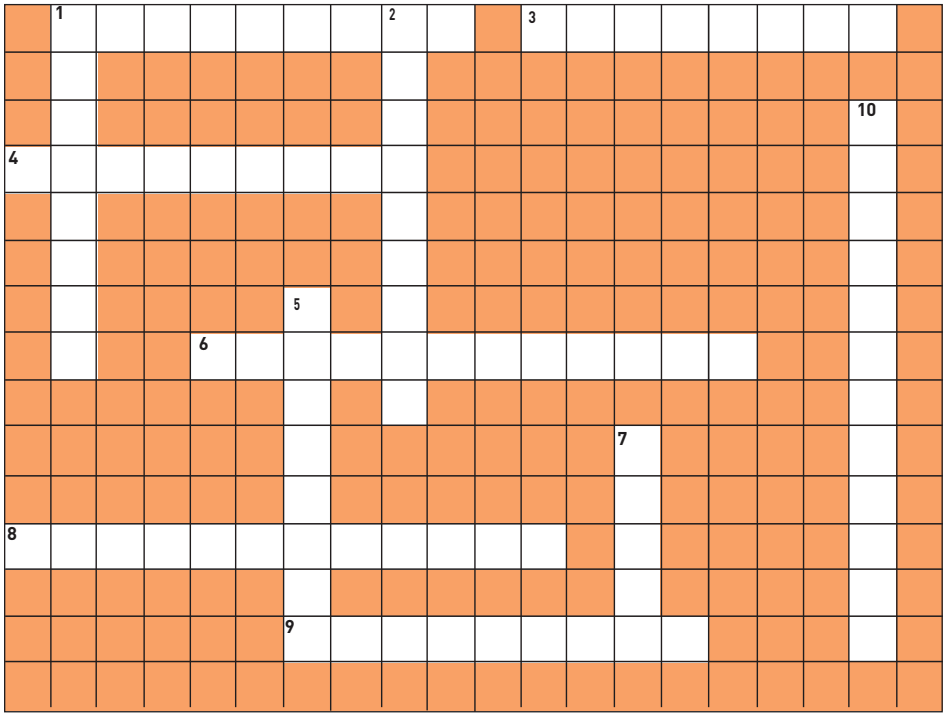
Here are some interesting facts about trees:

- The average tree has only 8 years of life expectancy in urban/city area
- About one third of the United States of America is covered by trees
- A single tree produces approximately 260 pounds of oxygen per year
- One tree can absorb as much carbon in a year as a car produces while driving 26000 miles.

Do your part. Plant a tree. Be a part of the movement. Our planet will thank you.

For more on how to conserve the trees, please visit: http://www.savatree.com/tree-facts.html

September Crossword



Created by crosswordpuzzlegames.com
Answers to the crossword are found on page 9.

ACROSS

1. A direct visual examination of internal structures of the digestive system using a fiber-optic tube.
3. A decrease in the blood supply to a body organ, tissue or part caused by constriction or obstruction of the blood vessels.
4. One who specializes in the provision of a particular treatment.
6. A myocardial infarction.
8. A substance that induces a false or distorted perception of objects or events.
9. An ecological community together with its environment functioning as a unit.

DOWN

1. A feeling of great happiness or well-being.
2. Minute disk-like cytoplasmic bodies in the blood plasma of mammals that promote blood clotting.
5. A bitter white alkaloid often derived from tea or coffee used in medicine as a mild stimulant.
7. A period of excessive indulgence in food or drink.
10. Formation of the nervous system.

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