Logbook-Calgary Youth Science Fair

By: Spencer and Semhar

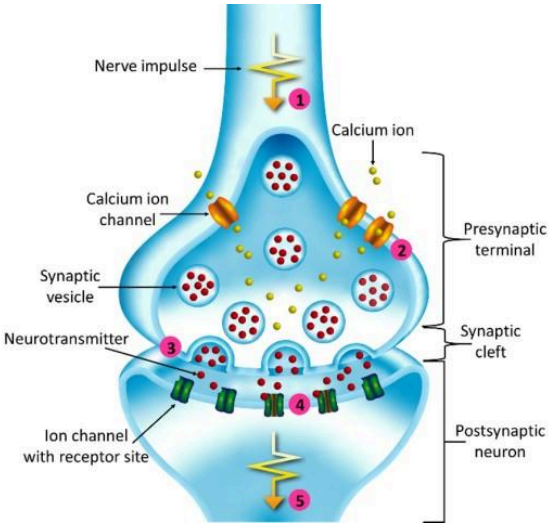
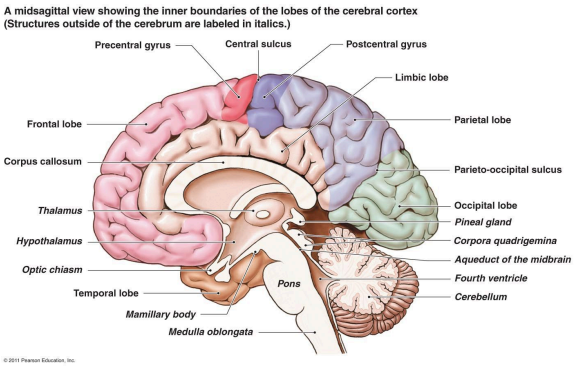
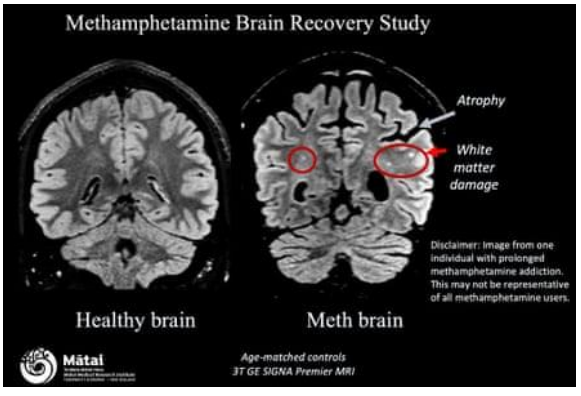
Date(attempted to do every week)	Progress
December 8th 2024	Signed up for the science fair club officially, and want to figure out a psych project. Starting with Ideas -Neurological differences between introverts and extroverts(previously done+hard to research) -Schizophrenia - peer pressure experiment (hard to set up and get participants) -Placebo +why it occurs
December 15th 2024	Continued looking into potential project ideas. Consulted teacher rep -Spencer: likes neurological differences between introverts and extroverts -Semhar: proposed new ideas for the project. Ex could do more drug-based ones. Also mental illness.
December 19	Paused project, going on break.
Jan 8th	Studying for finals so less time altogether. Found some cool sources for two front runners. https://pmc.ncbi.nlm.nih.gov/articles/PMC9080788/ Schizophrenia Drug use (kinda want to specify) https://americanaddictioncenters.org/health-complications-addiction/central-nervous-system -Want to talk about neurological impacts
jan 12 2025	-Talked to teacher rep. Decided on drug use

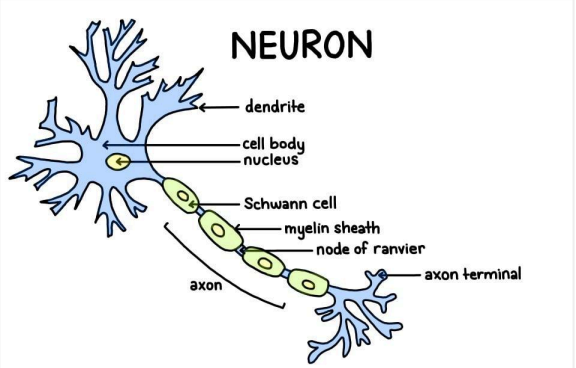
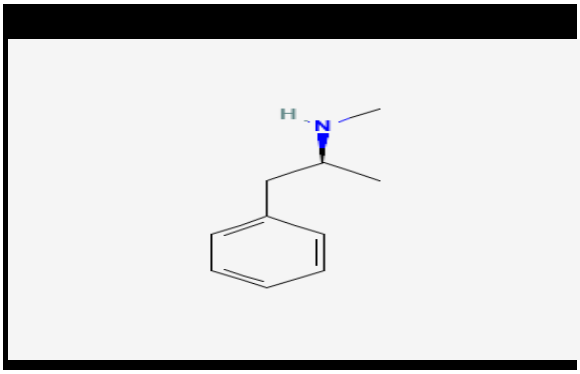
	research proj. Want to specify but don't know which drug
Jan 20th	Selected "The neurological implications of methamphetamine." chemical reasoning is very clear with meth. Good choice. Could talk about neurological implications and also progression down lineage.
Feb 6th	Officially registered. Using the name "The neurological implications of methamphetamine". Some good sources: https://pmc.ncbi.nlm.nih.gov/articles/PMC3148451/ https://www.biomolther.org/journal/view.html?uid=1246&vmd=Full https://www.canada.ca/en/health-canada/services/substance-use/controlled-illegal-drugs/methamphetamine.html
Feb 7th	Slight freak out over getting everything set up. Need to have it registered as a partnered project. Still working out collab+questions
Feb 21st	Questions to consider for project-leading questions. Draft 1. Impacts on society a)intro b)brief overview c)social implications 2. How does meth affect brain A)chemistry of meth implications b) how does it affect neurotransmitters c) Across synapse d)how does meth allow for oxidative stress +why is it bad 3. Impacts on different parts of the brain a)ex. Pre-frontal cortex 4. Affects on grey matter 5. Brain recovery 6. Down bloodline
March 1st	Long awaited start of the project: As stated in the intro, some stats to include: In 2021, according to the National Institute on Drug Abuse, over thirty thousand people

	overdosed due to the use of methamphetamine in the United States. -National Survey on Drug Use and Health from 2019, 4% of people in the United States struggle with a methamphetamine addiction. A study from 2009 showed that the odds of committing a homicide were nearly nine times greater for methamphetamine users.
March 2nd 2025	-triggers flight or flight response. Epinephrine. -stops dopamine reuptake. It increases the dopamine released steps solidified, in normal brain: 1. Action potential arrival- An electrical impulse travels from the axon (transmits electrical signal) down along the myelinated sheath in the presynaptic neuron until it eventually reaches the axon terminal. 2. The arrival of the action potential(electrical impulse) causes voltage-gated calcium channels in the pre-synaptic neuron to open, this allows for calcium to rush into the cell. 3. The increase in Ca+ in the synaptic vesicles causes the synaptic vesicles to fuse with the pre-synaptic membrane and release the neurotransmitters into the synaptic cleft (the space between neurons) 4. Neurotransmitters diffuse across the synapse and bind to receptors on the post-synaptic neuron to transmit the neuron signals across neurons. 5. Binding to the neuroreceptors can either inhibit or enable a response. This action either depolarizes (causes more transmission to other neurons)or hyperpolarizes(stops the transmission) the post-synaptic neuron.

	6. The signal after delivering its message is terminated from the synapse. It is terminated through reuptake into the neuron or is broken down by enzymes in the synapse.
March 4th	Looked into oxidative stress, excerpt from science org MA enters the neurons, displaces dopamine from its vesicles, and releases it into the synaptic cleft, resulting in high intracellular and synaptic dopamine levels. This leads to the auto-oxidation and increased metabolism of dopamine resulting the formation of various ROS, like hydrogen peroxide Oxidative stress is a principal factor involved in the destruction of dopaminergic neurons. These dying neurons release neuromelanin, which exacerbates neuroinflammation and the neurodegenerative process https://www.sciencedirect.com/science/article/pii/S0753332222009805
March 5th	Areas most affected by meth use: 1. The prefrontal cortex-breaks down grey matter 2. Hippocampus 3. Amygdala 4. Cerebellum = what causes poor motor control Biggest indicators -role of calcium and glutamate Excess extracellular glutamate can damage monoamine terminals independent of nNOS. Upon activation of its calcium-permeable NMDA or AMPA receptors, glutamate results in an increase in intracellular calcium, which in

	turn activates calcium-dependent enzymes and ultimately leads to cellular damage. Meth administration results in calpain-mediated spectrin proteolysis, which is associated with damage to striatal DA terminals **https://www.frontiersin.org/journals/neuroscience/articles/10.3389/fnins.2015.00069/full**
March 7th	Impacts on neural integrity, -Meth produces long-term consequences on the neural systems present in the human brain. The impacts of meth-induced dopamine reuptake and overstimulation can result in auto-oxidation which leads to further oxidative stress and neural degeneration. Meth also can induce apoptosis, self-induced cell death, leading to a reduction in neuron density. Meth can activate the mitochondrial pathway allowing for mitochondrial dysfunction over time due to oxidative stress. https://pmc.ncbi.nlm.nih.gov/articles/PMC10335775/
March 9th	Need to finish -on neuro-structures -bloodlines -potential remedies -citations -changes in personality -final edit
March 13th	Communication between regions -. The dysregulation of the dopamine pathway enables the disfunction of dopamine-based neural pathways in the brain. The nucleus accumbens a structure in the dopamine pathway and also experiences immense over-stimulation. This causes reward-seeking behavior often known as addiction. Furthermore, meth also alters signaling between the striatum and the prefrontal cortex which is incredibly harmful. -the dopamine pathways essentially die and

	then limit the ability of excitatory neurotransmitter travel. Down axon
March 17th	-need to still finish everything + sources of error New images found:   

	 
March 18th	-Looked over and formatted research.

March 19th	-did citations: Luvsannyam, Enkhmaa, et al. “Neurobiology of Schizophrenia: A Comprehensive Review.” *Cureus*, Apr. 2022, https://doi.org/10.7759/cureus.23959. Editorial Staff. “How Do Drugs and Alcohol Affect the Brain and Central Nervous System?” *American Addiction Centers*, 17 Dec. 2024, americanaddictioncenters.org/health-complications-addiction/central-nervous-system. “What Does Meth Do to Your Brain?” *American Addiction Centers*, 16 Nov. 2024, americanaddictioncenters.org/stimulants/meth/effects-on-the-brain. PubChem. “Methamphetamine.” *PubChem*,

pubchem.ncbi.nlm.nih.gov/compound/Methamphetamine

Admin. “A Closer Look at Methamphetamine Structure - Haven Detox Little Rock.” *The Haven Detox*, 30 July 2024, arkansasrecovery.com/meth-treatment/methamphetamine-addiction-and-recovery/a-closer-look-at-methamphetamine-structure.

Turan, Çetin, et al. “Oxidative Stress and Inflammatory Biomarkers in People With Methamphetamine Use Disorder.” *Clinical Psychopharmacology and Neuroscience*, vol. 21, no. 3, July 2023, pp. 572–82. https://doi.org/10.9758/cpn.22.1047.

Northrop, Nicole A. “Methamphetamine Effects on Blood-brain Barrier Structure and Function.” *Frontiers in Neuroscience*, vol. 9, Jan. 2015, https://doi.org/10.3389/fnins.2015.00069.

The Recovery Village Drug and Alcohol Rehab. “What Does Meth Do to the Brain? Brain Damage and Long-Term Effects.” *The Recovery Village Drug and Alcohol Rehab*, 17 Dec. 2024, www.therecoveryvillage.com/meth-addiction/meth-affect-brain.

Gold, Mark S., et al. “Methamphetamine- and Trauma-Induced Brain Injuries: Comparative Cellular and Molecular Neurobiological Substrates.” *Biological Psychiatry*, vol. 66, no. 2, Apr. 2009, pp. 118–27. https://doi.org/10.1016/j.biopsych.2009.02.021.

“Methamphetamine- and Trauma-Induced Brain Injuries: Comparative Cellular and Molecular Neurobiological Substrates.” *Biological Psychiatry*, vol. 66, no. 2, Apr. 2009, pp. 118–27. https://doi.org/10.1016/j.biopsych.2009.02.021.

Friedman, Courtney. “Meth Can Damage Brain Like Traumatic Brain Injuries, One Treatment Is Helping With Both.” *Be Well Texas*, 22 Oct. 2024, bewelltexas.org/meth-can-damage-brain-like-traumatic-brain-injuries-one-treatment-is-helping-with-both.

London, Edythe D., et al. “Chronic Methamphetamine Abuse and Corticostriatal Deficits Revealed by Neuroimaging.” *Brain Research*, vol. 1628, Nov. 2014, pp. 174–85. https://doi.org/10.1016/j.brainres.2014.10.044.

LMSW, Stacy Mosel. “Brain Damage From Drugs and Alcohol: Are Effects Reversible?” *American Addiction Centers*, 16 Dec. 2024, americanaddictioncenters.org/alcohol/risks-effects-dangers/brain.

Zhang, Zhixue, et al. “Alteration of Brain Structure With Long-Term Abstinence of Methamphetamine by Voxel-Based Morphometry.” *Frontiers in Psychiatry*, vol. 9, Dec. 2018, https://doi.org/10.3389/fpsyt.2018.00722.

	Szalavitz, Maia. “Genetics: No More Addictive Personality.” *Nature*, vol. 522, no. 7557, June 2015, pp. S48–49. https://doi.org/10.1038/522s48a. Cecil, C. a M., et al. “DNA Methylation and Substance-use Risk: A Prospective, Genome-wide Study Spanning Gestation to Adolescence.” *Translational Psychiatry*, vol. 6, no. 12, Dec. 2016, p. e976. https://doi.org/10.1038/tp.2016.247. Images: *“Alteration of Brain Structure With Long-Term Abstinence of Methamphetamine by Voxel-Based Morphometry.”* https://doi.org/10.3389/fpsyt.2018.00722. *“Diagram of Synaptic Transmission.” Okinawa Institute of Science and Technology*, www.oist.jp/image/diagram-synaptic-transmission. *Your Brain: An Introduction to Its Anatomy – MGH MAPP*. mapp.mgh.harvard.edu/your-brain-an-introduction-to-its-anatomy. *“Can Brains Bounce Back? Recovering Addicts Turn to Science to Map the Effects of Meth.” The Guardian*, www.theguardian.com/world/2023/may/06/can-brains-bounce-back-recovering-addicts-turn-to-science-to-map-the-effects-of-meth. *“Neurons (Nerve Cells): Structure, Function &Amp; Types.” Simply Psychology*, www.simplypsychology.org/neuron.html. GREG DUNN NEURO ART. “Brain and Neuroscience Fine Art Paintings.” *Google Image Result for Https://I.Pinimg.Com/736x/49/Ff/Ff/49ffff3ea8f706ce49f7262d8cdbfee2.Jpg*, images.app.goo.gl/gKN3qPJoEbNseK776. Accessed 21 Mar. 2025. *brain-anatomy-illustration*. https://stockcake.com/i/brain-anatomy-illustration_978591_934875.
March 20th	Did sources of error: In a research project, there will always be chances of bias and sample issues within different experimental studies. We tried our best to properly use the information from a variety of reliable sources.

	There could be issues of selection bias for the participants in the studies we mentioned. Addiction center studies may be more geared towards overstating the dangers of drugs and painting them in a particular light. Additionally, studies or sources sometimes may overgeneralize the symptoms and impacts of drug use. Meth is a substance that does not result in the same effects for all people. Furthermore, meth is also a more recent phenomenon, and because of this, it is often hard to get full certainty on the long-term effects. Meth also has a social stigma attached to it. This results in skewed data in some cases because a certain outcome is desired. Overall we tried to draw from a variety of sources that had notoriety. Through this, we were able to compile information that was accurate for our project. Finished the rest of the project too. +uploaded images to project+ final editing