Supporting Students with FASD and Trauma

by

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We accept this Project as conforming to the required standard.

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Abstract

Fetal Alcohol Spectrum Disorder is a neurodevelopmental disorder which is caused from prenatal consumption of alcohol. Children who are living with FASD, and who have also experienced trauma in some form, experience significant challenges when it comes to executive functioning and social emotional learning. Executive functioning and social emotional learning are key areas that both children and adults need proficiency in order to lead healthy lives, have healthy relationships, be successful in school, and maintain jobs/careers. This project includes a multi lesson unit plan titled: ‘Supporting Students with FASD and Trauma with the Help of STEM.’ This multi lesson unit plan connects to the BC curriculum and is designed for grade 4 students. This unit plan includes activities and lessons that are meant to directly teach valuable skills associated with executive functioning and social emotional learning. Participating students are given the opportunity to practice these skills in a safe and practical way by participating in solving STEM problems. Key skills include: self-regulation, goal setting, reflection, perseverance, problem solving, and leadership skills.

Keywords: Fetal alcohol spectrum disorder, trauma, executive functioning, social emotional learning, curriculum, and STEM (Science, Technology, Engineering, and Math).
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Dedication

To the Lloyd’s in my life. To my little brother Lloyd Hogue Jr. who is just about to start his educational journey. I wish you success in your journey through higher education! I would also like to dedicate this project to my Papa, Lloyd Hogue Sr. who cared deeply about education. Thank you for your encouragement and love.
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Chapter 1

Introduction

Statement of Problem:

The learning journey is difficult for many children, and learning is particularly challenging for students who suffer from deficits related to Fetal Alcohol Spectrum Disorder (henceforth FASD). FASD is essentially trauma to the brain caused by prenatal alcohol exposure (PAE). Challenges for children with FASD are dramatically amplified when one takes into account the fact that many children who suffer from FASD also suffer from other forms of trauma. This trauma may include emotional, physical, or sexual abuse, or may come in the form of neglect. To address the need to help students who are living with FASD and trauma be successful in the classroom, I will create a unit plan that will not only provide teachers with tools to meet the needs of these unique learners, but this unit plan will also meet the curricular competencies for the New BC Curriculum’s grade 4 Applied Design Skills and Technology (ADST) outcomes. According to the Province of British Columbia, ADST is: ‘The ability to design, make, acquire, and apply skills and technology”. ADST is described by the New BC Curriculum’s website as an important part of today’s world; “ADST allows students to use creativity, problem solving, and critical thinking skills to find solutions that fit a problem”. (Province of British Columbia, 2018). In comparison STEM is an interdisciplinary approach to teaching the 4 STEM subjects which are: science, technology, engineering, and math. STEM usually includes hands on learning and includes real world problems (Hom, 2014).

Background

FASD is a preventable neurodevelopmental disorder that is caused when a mother drinks alcohol during her pregnancy. “Fetal Alcohol Spectrum Disorders (FASD) is an umbrella term
used to classify a range of disabilities caused by prenatal alcohol exposure (PAE) including physical, cognitive, emotional, and behavioural deficits” (Poth, Pei, Job, & Wyper, 2014, p. 247). When alcohol is consumed by a mother during her pregnancy the alcohol passes through the placenta and disrupts the growth of the fetus’ body and brain development (Price, Cook, Norgate, & Mukherjee, 2017, p. 89). “The type and scale of fetal damage depends on the amount, frequency and timing of alcohol exposure, as well as several other factors including maternal nutrition, metabolism, and genetics” (Price et al., 2017, p. 89). When children with FASD reach school age many have unique learning needs; 20% of children with FASD have an IQ of 70 or lower, and the average IQ scores of children with FASD are between 70 and 90 (Dybdohl & Ryan, 2009, p. 186).

FASD is associated with discrimination and shame, and it is often difficult to diagnose, even with obvious signs (Chamberlain, Reid, Warner, Shelton, & Dawe, 2017). According to Pei and Rinaldi (2004) “three key problems plague the FASD field: 1. problems with diagnostic consistency, 2. lack of knowledge of FASD and appropriate interventions for FASD, and 3. public policy and funding initiatives that fail to effectively address the diverse needs of this population” (p. 126). As a result of the difficulty in diagnosing students living with FASD, these students often do not get the help that they need. Students with FASD may have a range of cognitive and social emotional deficits including: weak memory, weak retention, poor abstract reasoning, poor information transfer, emotional outbursts, poor empathy, and a narrow social conscious (Poth, Pei, Job, & Wyper, 2014).

Teachers often come out of preservice education programs lacking training on helping students with deficits typical of FASD (Dybdahl & Ryan, 2009). Poth, Pei, Job & Wyper (2014) stressed the need for additional training for not only classroom teachers, but also special
education teachers and speech language pathologists. Noted within this 2009 article are 3 separate studies from Canada, U.S., and the U.K. All three studies ultimately concluded that further learning opportunities for teachers concerning FASD are needed. “Improved awareness and education is imperative if educators and allied professionals are to understand and respond to the unique needs of students with FASD in ways that allow these students to maximize their potential and achieve educational, social, and behavioural goals” (Poth, Pei, Job, & Wyper, 2014 p. 325). Teaching resources on the topic of helping students with FASD become successful in the classroom is lacking. Additionally, Dybdahl and Ryan (2010) found that most of the classroom teachers had not had any training for FASD inclusion or the participating teachers determined that the training was ineffective. The authors recommended that more in-service training about the inclusion of FASD students should be developed for teachers.

FASD and trauma usually go hand in hand. 61% of children with FASD have experienced at least one significant traumatic experience in their lives (Henry & Back-Pond, 2004, p. 8). Both FASD and trauma affect the “neurophysiological growth of the brain, nervous system, and endocrine system, along with psycho- social development, including personality formation, social conduct, and capacity for relationships” (Sloane & Black-Pond, 2007, p. 100). Trauma can impact a child’s personality development, attitude, learning, and relationships (Wright, 2017, p. 141). Trauma is not an event itself, but instead a name for the reaction in which an individual has to a very stressful event or situation; “trauma occurs when an external event overwhelms one’s ability to cope, leaving him or her temporarily helpless” (Wright, 2017, p.142). Trauma causes children to “operate in an overwhelming state of stress, the stress response system may become the normal mode of functioning. Consequently, even when actual danger is not present, children may react to the world as if they are” (Wright, 2017, p. 142). As a
result, children who are victims of trauma may experience anxiety, frighten easily, be clingy, aggressive, impulsive, they may have difficulty sleeping or experience nightmares or bedwetting, demand both negative or positive attention, lack self-confidence, have stomachaches or headaches, or have difficulty focusing (Wright, 2017). As a result of the complex needs and behaviours of children who have experienced trauma, it is imperative that teachers receive adequate training and resources to help best support students who have experienced trauma. This is even more imperative for teachers who are teaching students with FASD who are coping with trauma.

**My Experiences**

I choose to become a teacher because I want to make a direct difference in my community, and helping children build the essential skills to be successful at school and beyond is something that is valuable, essential, and something that I have always wanted to be part of. As a Metis teacher, I have always been passionate about First Nations education. The journey my career has taken me on so far has led me to teach grades 2-5 at two different First Nations schools here on Vancouver Island before I accepted my current position as a student support teacher on Gabriola Island. Most of my years of teaching have been in multi-grade classrooms and a high population of the students I have taught have been high needs students. During my years of teaching experience, I have taught many students with a diagnosis of FASD and other students who I suspected had FASD, but were undiagnosed. FASD affects some individuals differently than others. Students living with FASD are all very unique in terms of their strengths and weaknesses. Patterns I have noticed in students include: most of the students were significantly behind academically, most needed additional social and emotional support, and most had difficulty staying focused. As a result of the learning that I have gained from my
teaching experience so far, I feel that I need to learn more about both FASD and trauma to best support my highest needs students.

**Linking to the Topic of Special Education**

Students living with FASD struggle daily with damage to the central nervous system which causes a variety of learning and behavioural difficulties caused by prenatal alcohol exposure (University of Alberta, 2004, p.3). The prevalent trend in special education is for students with disabilities to learn in general education classrooms with their peer group; therefore, teachers must use behaviour management strategies, interventions, and routines that will help all of the students in their classroom learn and function to the best of their ability. As a result of the unique needs and potentially extreme behaviours of students with FASD, classroom teachers need to address the behaviour, attention, and executive functioning needs of students with FASD by customizing their classroom routines and curriculum to ensure the success of FASD students and other students in the classroom who may be also struggling with these same deficits. Dybdahl and Ryan (2010) concluded from their 3-year study of classroom teachers from the Pacific Northwest, that students with FASD need a structured environment, larger tasks broken up into smaller tasks, a predictable schedule, predictable rules and routines that hold the student accountable for actions, and a reduction of stimuli including light and sound. Therefore, a curriculum that addressed the learning gaps and allows opportunities for students to practice important skills such as following directions, self-regulation, exercising their memory, using their working memory with intertwined behaviour management strategies, routines, and social emotional learning opportunities would be beneficial to both teachers and students with FASD.

**Project Guiding Question**

This project will address the following research question: What teaching resources would
be useful for students who are impacted by FASD and trauma? In order to answer this question, exploration on the following topics will be necessary: What deficits do FASD students who have experienced trauma have? What supports do students with FASD need in the classroom? What knowledge do teachers have about FASD and trauma? I plan to address the need for more support for teachers concerning teaching students with FASD. This unit plan will target the grade 4 New B.C. Curriculum’s ADST (Applied Design, Skills, and Technologies) outcomes, and will also target key deficits that will help students who may be struggling with FASD and trauma in the classroom. The unit plan will not only include STEM (Science, Technology, Engineering, and Math) activities it will also address social emotional issues including: social skills, managing emotions, and relationship building. This unit plan will also include: fine and gross motor practice activities, and address executive functioning deficits such as the ability to following directions, working cooperativity with others, time management, and goal setting. These skills will be learned in a safe and fun way. Additionally, I plan to include behaviour management strategies that can carry forward into other subject areas in the classroom. The goal for this unit plan is to help teachers feel more prepared to teach students with FASD, and for students with FASD to experience more success in the classroom.

Overview of the Project

This project will be on the topics of FASD and trauma, and will include a usable unit plan that will not only meet the expectations for the New BC Curriculum’s grade 4 ADST curricular competencies, but it will also include strategies and activities that will help teachers who may be teaching students with FASD. This unit will provide directions for STEM activities along with teaching strategies, routines, behaviour management strategies, activities, and interventions that will help not only FASD students, but all students who struggle with behaviour, attention, and
executive functioning deficits. This unit plan will link together social emotional learning strategies along with other teaching strategies to help with attention, motor difficulties, and executive functioning deficits. This resource will be filled with evidence-based advice and strategies that will help support teachers in their role of teaching students with FASD. My other goal is for this unit to help to create a safe and positive learning environment, and provide teaching strategies that will encourage high expectations for all students.

Chapter 2

Literature Review

Definitions

“Fetal Alcohol Spectrum Disorder is a life-long disorder that dramatically affects a child’s learning, behaviour, development, family, and quality of life” (Reggie, & Xu, 2013, p. 43). Students with FASD face a variety of cognitive, behavioural, and developmental challenges. Teachers and caregivers need additional resources, interventions, and support when it comes to teaching and caring for students with FASD. Students with FASD are often lacking confidence, a supportive home environment, and personal motivation. Teachers are in the unique role to help students with FASD, but first teachers need to be better informed about FASD and the interventions and supports available to help students with FASD (Alberta Learning, 2004).

Trauma and FASD are often linked. Trauma, whether physical, sexual, emotional abuse, or neglect can have serious consequences for child development (Henry, Sloane, & Black-Pond, 2007). The purpose of this review is to examine the literature on the topics of FASD, childhood trauma, and classroom interventions to best support children with FASD and trauma.

Fetal Alcohol Spectrum Disorder

“Fetal alcohol spectrum disorder (FASD) is the umbrella term to denote the range of
conditions that arise from prenatal exposure to alcohol” (Nash, Stevens, Greenbaum, Weiner, Koren, & Rovet, 2015, p. 191). FASD is a lifelong disablement and people living with FASD need supports in order to lead happy and fulfilling lives and be functioning members of society (Reid, et al., 2015). The consequences of drinking alcohol during pregnancy has been noted as far back as Aristotle’s writing (Alberta Learning, 2004). “In 1899, British physician H.W. Sullivan linked alcohol use during pregnancy to poor birth outcomes in a study of women in the British prison system” (Alberta Learning, 2004, p. 4). It was not until 1973 that FASD was discovered. Pediatricians, David W. Smith and Kenneth L. Jones were studying dysmorphology, which is the study of congenital birth defects, at the University of Washington. This first study of children with FASD included 8 children who all had similar growth deficiencies including an unusually small head and cognitive delays (O’Neil, 2011). Dr. Smith and Dr. Jones studied the pattern of facial features, developmental delays, and neurological defects and ultimately discovered that the mothers of the children they were studying were alcoholics, and they linked together the children’s deficits with the prenatal alcohol exposure (O’Neil, 2011). According to the Government of Canada, “it is estimated that in Canada, more than 3,000 babies a year are born with FASD, and about 300,000 people are currently living with it” (2017 p#?).

**Trauma and FASD:**

Henry, Sloane, and Black-Pond (2007) analyzed the neuro-developmental impact of childhood trauma with and without prenatal alcohol exposure (PAE). The authors state that both the topics of FASD and trauma have been well researched, but “there is no research documenting the concurrent effects of PAE and postnatal trauma on a child’s developmental process” (p. 99). The authors also claim that this is the first study of its kind. The 115 participants of this study were between the ages of 6 and 16. Ninety-seven percent of the children participating in the
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study were determined as moderately to severely traumatized, this was determined with the help of the Children’s Trauma Assessment Centre (Henry, Sloane, & Black-Pond, 2007). The methods used for this study included transdisciplinary assessments of children including teachers, occupational therapists, speech language pathologists, social workers, and medical doctors. The study used a mixed methods approach which included: “standardized developmental and intelligence testing projective tools, parent questionnaires, and psychosocial interviews” (Henry, Sloane, & Black-Pond, 2007, p. 99). The study found that PAE combined with child trauma can have “deleterious effects on child development across multiple domains” (Henry, Sloane, & Black-Pond, 2007, p. 103). Children with both trauma and FASD had lower intelligence scores. “Four of the eight neuro-developmental constructs measured revealed a greater percentage of children with trauma/FASD having moderate/major delays as compared to children with trauma/no FASD” (Henry, Sloane, & Black-Pond, 2007, p. 104). Both groups of children were at risk for learning disabilities and memory deficits. One of the strengths of this article is noted by the authors: “there is no research documenting the concurrent effects of PAE and postnatal trauma on a child’s developmental process” (p. 106). The authors recommend that more research needs to go into helping children who are effected by both trauma and FASD and that teachers and caregivers often have limited knowledge about how to best help children with FASD and often label them as lazy or defiant. The authors suggest that more research and awareness needs to raised, and coping strategies and interventions need to be implemented to provide opportunities for success for children with FASD and trauma (Henry, Sloane, & Black-Pond, 2007, p.106).

Teacher’s Knowledge of FASD

Pei, Job, Poth, O’Brien-Langer, and Tang (2015) explore the issue of student teachers
and their understanding of FASD. They ask the question: are student teachers leaving university prepared with the tools and knowledge to effectively teach students living with FASD? The researchers conducted a study of 77 student teachers at a university in western Canada. The authors used a mixed-methods approach to this study by designing an online survey to “examine data patterns related to the knowledge and beliefs of pre-service teachers as they relate to teaching students with FASD” (p. 134). The questions were designed to find out what knowledge the teachers had about FASD, and how the teachers would approach the learning needs and behaviours of students with FASD. The survey included a variety of open-ended questions to get a better understanding of the student teacher’s understanding of FASD. The data analysis of this study happened in two steps: “The quantitative data was analyzed using Predictive Analytics Software (PASW) Statistics version 20, to generate descriptive and inferential statistics” (Pei, et al., 2015, p. 137). The researchers analyzed the qualitative data from the 3 open ended questions in 3 different steps that included coding of participants and analyzing similarities and differences between answers (Pei, et al., 2015).

The findings of this study suggested that the student teachers who participated in the study had a limited knowledge of FASD and its associated defects, and that this limited knowledge would most likely hinder teacher recognition of student learning needs. The study also found that student teachers had a lack of knowledge about the causes of FASD and the possible interventions (Pei, et al., 2015). In 2015, when this study was conducted, it was only the second study of its kind relating to student teachers and their knowledge of FASD. Limitations of this study include the fact that all of the participants came from one Canadian university, and furthermore all of the participants were student teachers who were only part way through their education degrees. The study does not say how close to graduation the student teachers were,
therefore it is important to note the study does not reflect accurately on the knowledge of Canadian teachers, only student teachers at one university.

In comparison, the authors of Alberta Learning (2004) also agree that teachers need more training opportunities to gain a deeper understanding of FASD. The authors also mention that, with this training, teachers and caregivers need to shift their thinking about FASD. The authors also note that teachers, doctors, social workers, and other professionals need to come together to educate and support one another to come up with effective approaches to meet the needs of children living with FASD (Alberta Learning, 2004).

The Importance of Diagnosing FASD

The central argument for Alberta Learning’s paper is surrounding the value of diagnosing FASD. Diagnosing, according to Alberta Learning, is valuable for individualized programming and interventions, assistance within the community, and for building empathy from others (2004). Pei and Rinaldi (2004) discuss the importance of diagnosing FASD and how difficult it is to diagnose FASD. They note that “three key problems plague the FASD field: 1. Problems with diagnostic consistency, 2. Lack of knowledge of FASD and appropriate interventions for FASD, and 3. Public policy and funding initiatives that fail to effectively address the diverse needs of this population” (Pei, & Rinaldi, 2004, p. 126). The authors argue that interventions for students with FASD are lacking because perceptions about children with FASD need to change. Students with FASD are often viewed as “disobedient and they should be viewed as ‘disabled’” (Pei & Rinaldi, 2004). When perceptions about FASD change more research and better diagnostic practices will be developed for students with FASD. There is evidence that early interventions and accurate diagnosis could prevent social skills deficits as children grow older (Pei & Rinaldi, 2004). In support, Alberta Learning also noted the importance of proper diagnosis of FASD:
When negative behaviours and learning disabilities are misinterpreted, children may be punished because they are perceived as oppositional. They may develop severe emotional problems that arise from frustrations, inappropriate management and lack of support. Understanding the link between behaviour and learning problems, and the neurological impairments of FASD is one outcome of an effective diagnosis. (Alberta Learning, 2004, p.10)

Equally important, “when clinicians understand that the child has a complex profile of cognitive or behavior difficulties, then alcohol-related damage may be one antecedent in a larger set of etiological factors” (Clarren, Carmichael, Olsen, & Astley, 2000, p. 307). Children with FASD typically have a combination of different conditions including but not limited to ADHD, learning delays, language processing disorders, and difficulty in planning and judgment (Clarren, Carmichael, Olsen, & Astley, 2000). Additionally, secondary disabilities may emerge from frustrations, failures, and lack of acceptance from peers and adults (Clarren, Carmichael, Olsen, & Astley, 2000). Proper diagnosis will help caregivers, doctors, and other professionals beware of, and look for other conditions and also to help provide interventions as needed. Proper diagnosis will often change attitudes of family and peers, and help professionals such as doctors, speech language pathologists, occupational therapists find and look for secondary disorders. Proper diagnosis will help others see the child’s behavior as ‘can’t’ versus ‘wont’ and therefore build more empathy for the child diagnosed with FASD (Clarren, Carmichael, Olsen, & Astley, 2000). As noted, proper and early diagnosis of FASD is critical for students living with FASD to receive early interventions for social emotional learning, behaviour management, executive functioning deficits, and health related issues.

Interventions:
As previously mentioned, proper diagnosis is important for individuals with FASD and proper interventions need to be put in place to help focus on improving the lives of people living with FASD. Two organizations are mentioned by the authors of the article: ‘Neuropsychological aspects of preventions and interventions for FASD in Canada’ that support research initiatives that support children with FASD: CanFASD and NeuroDevNet are both conducting research about FASD prevention and interventions to help inform policy concerning diagnosing, prevention, and intervention in Canada (Pei, Tremblay, McNeil, Poole, & McFarlane, 2017). “CanFASD is a collaborative, interdisciplinary research network, with collaborators, researchers and partners across the nation. It is Canada’s first comprehensive national FASD research network” (CanFASD, 2018). NeuroDevNet is a network of health professionals and researchers who share the common goal of helping kids who have neurodisabilities. NeuroDevNet was awarded a $39.1 million grant to spend between 2009 and 2019 to help understand brain development and the causes of neurodevelopmental disorders (Pei, Tremblay, McNeil, Poole, & McFarlane, 2017). NeuroDevNet’s focus towards helping children with FASD targets the following research initiatives: multi-site imaging study, eye tracking as a screening tool for FASD, developmental planning for children in care, strongest families in FASD, strength based programing for youth with FASD, and navigation and support for families raising children with FASD” (Kids Brain Health Network, 2018).

In addition to NeuroDevNet and CanFASD a few other studies have been completed on interventions targeted at helping school aged children with FASD. The Alert Program for self-regulation has been tested in Canada, Math Interactive Learning Experience (MILE) is an American program that has been investigated by Canadian researchers, and Rehearsal Training is a working memory performance program that was tested on 33 children with FASD (Pei,
Tremblay, McNeil, Poole, McFarlane, 2017). Researchers at the University of Victoria developed and tested a program titled ‘Cognitive Carnival’ which is a computerized processing approach training program that is designed to test working memory, attention, and inhibitory control. This study was unique because each participant who participated in the study worked directly with a trained interventionist who supported each participant with metacognitive strategies and diffusion tensor imaging results showed neural differences in the intervention groups (Pei, Tremblay, McNeil, Poole, & McFarlane, 2017). Family based interventions such as Breaking the Cycle (BTC) are the more typical type of interventions for supporting students with FASD. BTC is a program meant to support drug and alcohol dependent mothers and their families. The program includes counselling, parenting workshops, early childhood interventions, based needs support, as well as medical services (Pei, Tremblay, McNeil, Poole, & McFarlane, 2017).

Social Emotional Learning and Self-Regulation:

To determine if children with FASD can learn social skills using a 12-week program called Child Friendship Training (CFT), and if the children could retain the knowledge of social skills they gained over the three-month period, researchers conducted a controlled social skills training for children with fetal alcohol spectrum disorder (O’Conner, Frankel, Schonfeld, Carpenter, Laugeson, & Marquardt, 2007). This study was completed at the University of California. The study included participants who were between 6 and 12 years old, who met the qualification of having documented prenatal alcohol exposure, measurable social skills deficits using the Socialization domain of Vineland Adaptive Behaviour Scales, and who had to have a verbal IQ of 70 (O’Conner et al., 2007). This study included attending 12 sessions of the CFT group. Each session was 90 minutes in length and included social skills training including:
having a conversation, joining a group of children already at play, how to be a good sport, how to handle teasing, and bullies and conflict situations (O’Conner et al., 2007). Parents and teachers were also given assessments about the children’s social skills. The results found that the children saw a significant increase in their knowledge of appropriate social skills after the CFT training and after the three-month follow up the results stayed the same and results from the controlled delayed group found similar findings.

This study shows that children with FASD can learn new social skills and retain the new information that they had learned for at least 3 months. According to the authors, this study was the first controlled study aimed at improving the social skills of children with FASD (O’Conner et al., 2007). It is important to note that this study’s participants all had a verbal IQ of 70 or higher and for that reason, a significant population of children with FASD were left out of this study who may have had different results with the CFT training. It might also be important to question whether or not only highly motivated families were willing to participate in their study, and if they did extra social skills practice and reinforcement at home after the 12 weeks of training. Lastly, as the authors note, this study was conducted at a university in a very controlled setting, would the results have been different if the study had happened at a daycare or school where real social interactions between children occur?

Similarly, a 2013 study showed that Aggression Replacement Training (ART) can help children suffering from emotional and behavioural problems. The goal of ART is to teach children with emotional and behavioural problems, social skills, managing big emotions, how to build respectful relationships, and how to take responsibility for own actions. Amedola and Oliver (2013) discuss the effectiveness of the ART program by running a 12-week program at Perseus House, a youth organization in Erie Pennsylvania. The participating youth were referred
by the juvenile courts and were all victims of childhood trauma, and suffering from social emotional problems, and all had a criminal past. The hour-long ART sessions occurred 3 times a week, and included training on anger control, skills to recognize body language, discussions concerning empathy and social values, and discussions surrounding self-triggers, self-evaluation skills, and self-regulation strategies (Amedola & Oliver, 2013). The results of the study were determined by a series of questionnaires. The study used: Aggression Questionnaire, Global Assessment of Functioning Test, and a How I Think questionnaire. The results determined that participants showed an increase in social skills, achievement, and overall physiological and social functioning and the re-arrest rate for participants for a 12-month period following the program was only 10.5% (Amendola & Oliver, 2013).

Weaknesses of Amendola and Oliver’s study include that fact that an additional program called the Trauma Focused Cognitive Behavioural Therapy (TF-CBT) Program was running at the Perseus House at the same time as the ART Program, therefore it is hard to really determine if the ART program by itself caused such positive results or how much influence the TF-CBT program had over the results. This study may need to be redone with just the ART program, or perhaps the researchers need to evaluate the results of both programs running together in the study’s results. Another criticism is the fact that the study was performed on youth who had already had ‘runs ins’ with the law, perhaps this program would be more beneficial as a preventative program for high risk children. The authors do mentions that other studies, in the past, have been published about the ART program, but this study was a larger of all of the studies (Amedola & Oliver, 2013). The outcome of this program was successful, but the validity of the research is hard to determine as the other program with similar goals was running at the same time and could have altered the results.
Emotional and Behaviour Issues

“In addition to the neurocognitive effects, PAE is associated with serious mental health problems including debilitating emotional and behavioural disorders and substance abuse problems” (Green, 2007, 103). In a study of psychiatric disorders exhibited in children with PAE between the ages of 5 and 7 (2002) it was found that 94% of the children with FASD also had an additional mental health problem (Green, 2007). Although ADHD is the most common, depression, oppositional defiant disorder, conduct disorder, anxiety disorders, and bipolar disorders are all reported diagnosis of children and adults with living with FASD (Green, 2007). Children with PAE also often suffer from low self-esteem, social isolation, and mood disorders. Green mentions that early diagnosis and interventions is key to helping children and their families cope and function with the neuropsychological, social, and emotional effects associated with FASD (Green, 2007). Interventions at school to help students with FASD have a positive social and learning experience include: the use of visual cues and visual schedules, directly teaching problem solving skills, social skills programs that include role playing (Green, 2007). Children with FASD “need opportunities to learn and build skills that will help them regulate their emotions and behaviors as well as environmental modifications that increase the likelihood of adaptive behaviours” (Green, 2007, p. 106). According to Alberta Learning (2004), parents and professionals need to shift thinking about FASD to stopping the perceived bad behaviours to preventing problems, modelling, using visual cues, changing environments, and behaviour modifications. Strong school and home relationships need to be built, and a team approach needs to be developed to helping classroom teaching meet the complex needs of students with FASD. (Alberta Learning, 2004).

Executive Functioning
A large amount of research has been completed on the topic of executive functioning deficits in children living with FASD, but there are very few studies surrounding the topic of how to repair executive functioning deficits in children with FASD (Nash, Stevens, Greenbaum, Weiner, Koren, & Rovet, 2015). Executive functioning is a term used to describe a range of mental activities including: “working memory, mental flexibility, utilization of feedback, planning and organization, and problem-solving skills” (Nash, et al., 2015, p.192). Self-regulation deficits are usually a predictor of behaviour disturbances, and delayed social skills and is a common deficit in children with FASD (Nash, et al., 2015).

The Alert Program for Self-Regulation is a program that is analyzed in a 2015 study. The Alert program is a “12-week manualized intervention that helps children to monitor, to maintain, and to regulate their levels of ‘alertness’ to match environmental needs” (Nash et al. 2015, p.193). Previous research on Alert has reported improved self-regulation for children with ‘emotional disturbance and conduct disorder’. This study was conducted on 25 children between the ages of 8 and 12 years old who have a diagnosis of FASD. “Different aspects of social and cognitive executive functioning were directly assessed using measures of attention, set shifting, planning, and social cognition, as well as parent rated questionnaires of executive functioning, behaviour problems, and social skills” (Nash et al., 2015, p. 193). The purpose of this study was to determine if self-regulation interventions can produce positive change. The results indicated positive change from the parent executive functioning questionnaire. The area of emotion control saw the biggest increase in the parent questionnaire.

“The children showed improvements in several areas of EF, including the ability to recognize basic emotions, but not all aspects improved following treatment. In fact, in both cognitive and socioaffective domains, it appears that children showed the greatest improvements
on simple (e.g., inhibition naming) rather than complex EF tasks (Nash et al. 2015). The authors were disappointed to discover that the children with FASD did not show improvements with the more complex tasks and the authors suggest in the discussion section that perhaps more research needs to be conducted surrounding executive functioning skills. Limitations of this study include the small sample size, the exclusion of children with FASD with a IQ of 70 or lower, and as the authors note, the study used standardized test scores rather than raw scores which may have influenced the findings (Nash et al. 2015).

In contrast, Fuglestad, Whitley, Carlson, Boys, Eckerle, Birgit, and Wozniak (2015) analyzed executive functioning in children with FASD prior to age 6 and learned that “executive functioning deficits manifest well before the age of 6 years in children with FASD, that they occur across the spectrum, and that executive functioning may be most impaired in children with more severe forms of FASD and/or lower IQs” (p. 730). Additionally, this study suggests that executive functioning can be malleable through interventions and suggests mindfulness, aerobic exercise, and classroom curricula to help improve executive functioning skills. The study suggests that all children with FASD would be appropriate targets for interventions, but those with more severe FASD and lower cognitive functioning may need more intense interventions (Fuglestad et al., 2015).

In 2013, a group of researchers from the Netherlands used Cogmed Working Memory Training RM which is used for children between the age of 7 and 17 years. This program consists of a variety of computerized, game-format, working memory tasks. The difficulty level of the games is adjusted automatically to match the working memory span of the child on each task. Children use this program for 5 weeks, 5 times a week, for approximately 45 minutes a day (Van der Donk, et al., 2013). In the second part of the study, researchers developed another
program that they called ‘Paying Attention in Class’. This program had the same amount of training required as the Cogmed Working Memory Training program, the goal of this program is to make student aware of the working memory required during in class time. This program addressed 5 different skills: paying attention, planning skills, working memory, goal-directed behaviour and metacognition (Van der Donk, et all, 2013). The authors determined that

There is limited, but promising evidence that working memory and other executive function interventions can improve academic performance. Little is known about the applicability and generalization effects of these interventions in a classroom situation [...] By taking into account the costs of both interventions, level of impairment and individual characteristics of the child (stepped-care approach) we will be able to address treatment more adequately for each individual in the future. (p 23)

Petty and Coelho de Souza, a research team in Brazil, researched how executive functioning can be improved by playing games in a 2012 study. Much like using STEM activities to help increase executive functioning skills such as attention, organization, self-control, and planning, this study asked the question, “can we stimulate children with learning disabilities to build up skills related to executive functioning in a context of games and problem solving?” (2012, p. 795). The children participating in the study learned rules to the games and built up strategies that led to competence in playing the games (Petty & Coelho de Souza, 2012). Study participants were between the ages of 7 and 11 and met for one hour once a week for three semesters before the intervention was complete. The study determined that “Participants who were engaged, and did not have serious neurological damages in brain functioning, really became students with better resources to deal with school challenges and they developed more adequate attitudes” (Petty & Coelho de Souza, 2012. p. 800). A connection can be made from
playing games to increase executive functioning skills to completing STEM activities to increasing the same executive functioning skills. Both games and STEM activities are highly structured, have rules, require socialization with peers, and practice problem solving skills. Therefore, structured in the appropriate way, STEM activities could improve executive functioning skills.

**Sensory Processing and Motor Control**

Sensory processing is the way that the nervous system receives messages from the senses and turns these messages into appropriate responses. In 2008, Researchers from the University of Washington completed a study on the relationship between problem behaviours and sensory processing disorders and found a correlation between behaviours and sensory processing. According to the authors, the relationship between problem behaviours and sensory processing deficits is not a topic that has been well researched (Franklin, Deitz, Jirikowic, & Astley, 2008). The study included 44 children who were between the ages of 5 and 10 years old and assessed and compared using retrospective data analysis. The study found that “deficits in sensory processing, which may contribute to a range of behavioural problems, may thus affect the ability of children with FASD to demonstrate adaptive responses to their environments” (Franklin et al., 2008, p. 272). Therefore, by helping children with FASD with their sensory processing deficits, this should make self-regulation and therefore behaviour management easier for students with FASD.

In a study of 26 Canadian children aged 5-10 years old with a diagnosis of FASD, the authors examined “the correlation between sensory processing, as measured by SSP total and section scores, and ADHD behaviour, as measured by ADHD Index Scores (ADHD Score) of the CPRS-R:L” (Abele-Webster et al., 2012, p. 60). The results of this study showed that a very
low correlation \( r = .02 \) between Short Sensory Profile scores and the attention deficit hyperactivity index of the Conners' Parent Rating Scales was found for the five- to ten-year-old children. Sensory processing problems were found in 81% of the children. According to the authors these findings can guide modifications of the environments, tasks, and approaches to children with fetal alcohol spectrum disorder (Abele-Webster et al., 2012, p. 63). The authors recommend that parents and caregivers should make sure that they have child’s full attention before speaking with them, children living with FASD would benefit from decreased classroom noise, and verbal instructions being kept to a minimum. Children with FASD may benefit from using earplugs or headphones to block out background noise. The authors state that having an FM amplification system set up in the classroom may be beneficial for children with FASD.

Motor problems are also prevalent in children with FASD “motor problems appear to be the result of teratogenic effects on both the central and peripheral nervous systems” (Coles, 2012, p.44). Children with FASD usually are present with early motor problems, with both fine and gross motor delays. Fine motor delays may affect: printing, hand eye coordination, eating with a utensil, math problems. Gross motor delays may include: walking and running issues and the child many appear to be excessively clumsy (Coles, 2012). “Damage to the cerebellum from heavy prenatal alcohol exposure may interfere with efficient use of visual and somatosensory system cues” (Coles, 2012, p.44). This means that students with sensory processing issues may be over sensitive to touch, pressure, pain, temperature, light, movement, and vibration.

**Linking STEM to Developmental and Intellectual Disabilities**

STEM is a learning approach that combines science, technology, engineering, and mathematics. These four key learning areas are combined with real life situations that “enable students to see the relationship between concepts and principals; students should be able to
understand how to use this knowledge and skills in everyday life” (Acar, Tertemiz, & Tasdemir, 2018, p.506). With STEM students look for solutions to everyday social, economic, and environmental problems. These problems should attract students to the topic as the problems should be relevant to student’s lives (Acar, Tertemiz, & Tasdemir, 2018). Curriculum in British Columbia as well as other parts of North America have had a focus on STEM learning as there are many job opportunities in the STEM areas. As pointed out by the authors of the article ‘Diversity in information systems: increasing opportunities in STEM for capable students with developmental and intellectual disabilities’, there are increasing opportunities for capable students with developmental and intellectual disabilities in the STEM industries as well (Lawler, Joseph, & Green, 2018). A program called Seidenberg School of Pace University is especially designed for middle and high school students who have an Individual Educational Plan, this program allows students to gain a portfolio of experience in many of the STEM areas (Lawler, Joseph, & Green, 2018).

There are many benefits to using a STEM curriculum. The benefits of using a STEM curriculum at the grade four level were discussed in the article: ‘The effects of STEM training on the academic achievement of 4th graders in science and mathematics and their views on STEM training teachers’. The authors found that students were able to: have more meaningful discussions surrounding their learning, have fun while learning, felt more encouraged about decision making, had improved technology skills, cooperated with their peers more easily, and completed activities faster and easier after participating in STEM lessons (Acar, Tertemiz, & Tasdemir, 2018). Furthermore, STEM courses require many executive functioning demands, according to Bellman and Burgstahler: “STEM courses demand planning, organizing, strategizing, paying attention to details, and managing time” (p.104). With proper interventions
using STEM training executive functioning skills in students with disabilities could be improved (Bellman & Burgstahler, 2015. A program developed through the University of Washington called AccessSTEM has these exact goals to provide academic coaching for study skills, improve self-confidence, motivation, time management, notetaking abilities, organization, prioritizing, writing, self-advocacy, and stress management using a STEM based curriculum. (Bellman & Burgstahler, 2015).

The quality of daily life for students especially those with disabilities is enhanced by STEM lessons; students with enhanced STEM knowledge are more likely to have greater work-related opportunities and problem solving strategies (Hwang & Taylor, 2016). STEM situations are fully embedded in daily life situations such as using chemicals and building furniture. Hwang and Taylor suggest using graphic organizers and visual tools to help show what students know, to bring out student creativity, and to make concepts concrete for students. STEM learning naturally encourages problem solving skills with real life problems. STEM encourages problem solving by “generalizing problem solving stories by engaging in hands on activities in the classroom” (Hwang & Taylor, 2016 p.44).

**Conclusion:**

The literature revealed that FASD is a life-long condition and children living with FASD live with a variety of developmental and cognitive impairments. Children living with FASD who have also experienced trauma, experience more severe deficits than children with FASD who have not experienced trauma, and most children who are living with FASD have experienced some kind of trauma in their lives. More training for teachers and caregivers is needed to best meet the needs of children with both FASD and trauma. The literature also showed that the earlier a child is diagnosed with FASD, the earlier they will receive support and interventions for
their deficits. Therefore, an early diagnosis is imperative. More research needs to go into helping children who are living with both FASD and trauma, and more research is also needed in the area of interventions for deficits of children with FASD particularly in the areas of executive functioning interventions and social emotional interventions. This applied project will meet this need by providing a grade 4, research based unit plan that will meet the needs of students living with FASD and who have experienced trauma. This STEM based unit plan will include a variety of interventions that will help improve self-regulation, social emotional skills, motivation and executive functioning deficits of students living with FASD.
Chapter 3

Project Proposal and Plan

Introduction

‘Supporting Students with FASD and Trauma with the Help of STEM’ is the title of a multi lesson unit plan that supports students who have FASD and have experienced trauma. The target skills of this unit plan include key deficits typical of students with FASD who have experienced trauma, including: social-emotional learning, self-regulation, and executive functioning interventions in the form of goal setting, being aware of strengths and weaknesses, problem solving opportunities, working on being a good team member, and being a team leader. These key skills will be taught to students alongside the hands-on learning that students will experience from the STEM activities provided within this unit plan.

The overall goal of this unit plan is for students to experience executive functioning interventions in a way that naturally happens when STEM opportunities are presented to students in a highly structured way, and when expectations and social skills are pre-taught and regularly reinforced. With these interventions and learning opportunities, students will gain valuable experience working with others in a positive way. Although there have been interventions and activities developed to help students with executive functioning deficits, none of the activities are presented in a unit plan that has the goals of teaching students these skills through STEM, and also reinforces: goal setting, reflection, and social skills through STEM activities. This unit plan also connects to the new BC curriculum. One of the main goals of this unit is for students to learn and practice social skills including: self-control, staying focused, and problem solving. Students will be able to use these new skills in other contexts in the future including at school and in the workplace.
Project Description

‘Supporting Student with FASD and Trauma with the Help of STEM’ is a 43 page resource written for BC grade 4 teachers to use in their classrooms. The unit plan is adaptable, hands-on, and connected to the BC curriculum. The unit plan includes a variety of different activities including all of the directions, posters, and worksheets that the classroom teacher will need to make the lessons within the unit successful in their classrooms.

The goals of the project

‘Supporting Student with FASD and Trauma with the Help of STEM’ is a multi-lesson unit plan that first provides a variety of targeted learning opportunities that get students prepared for working in groups, having self-confidence, and doing their share of the work. Students will be able to bring the leadership, perseverance, and collaboration skills that they learned from this unit plan into other classroom activities and other social situations. STEM naturally promotes higher level thinking including problem solving skills, and this unit plan is designed to set up the learning environment, so that all students can experience success. As Acar, Tertemiz, and Tasdemir state (2018), “STEM increases problem solving skills, creativity, and higher level thinking skills” (p. 506). Participating students will have the opportunity to get creative and design, build, test, and reflect upon a STEM problem that they, as part of a team, helped to solve. The STEM activities within this unit plan include building a catapult, marble maze, an invention that will help to improve their community in some way, and lastly an invention of their choice with limited materials. The activities not only encourage creative thinking, but also encourage the improvement and practice of social skills in a highly structured environment. To sum up the
goals of this project, participating grade 4 students will improve executive functioning skills such as problem solving, self-regulation, and reflection through practice and direct teaching.

Who is unit plan intended for?

This unit plan is designed to be used in grade 4 classrooms in British Columbia, Canada. The unit plan includes lesson and activity directions and a tips and tricks pages for teachers, and graphic organizers, worksheets, posters, and other visuals for students. The unit plan includes a variety of pre-teaching activities to get students ready for working in their STEM groups. The pre-teaching activities include leadership, perseverance, how to be a good team member, how to listen, and how to be a leader. Each of these activities is taught in a fun and dynamic way and can be adapted to meet the needs of everyone in the classroom. After the pre-teaching is complete, students then move onto the 4 multi-day STEM activities. Each of the STEM activities includes social emotional and leadership ideals embedded within the activities. Participating students will complete a self-assessment based on their: work ethic, contribution, their ability to get along with others and be a good listener, and they will set a goal for improvement for next time.

This Unit Plan and The BC Curriculum

In addition to meeting the needs of students with FASD who may have experienced trauma, this unit plan is also aligned with the new BC curriculum. This unit is linked to the grade 4 Applied Design, Skills, and Technologies curriculum. Within this unit, students are asked to design a prototype, and then build, test, and reflect upon their prototypes. ‘The Three Big Ideas’ found in the grade 4 ADST are embedded within this unit. The big ideas are: ‘designs can be improved with prototyping and testing’, ‘skills are developed through practice, effort, and
actions’, and ‘the choice of technology and tools depend on the task’ (Province of British Columbia, 2018). Additionally, embedded within this unit is a variety of ‘Curricular Competencies’ that connect to the BC curriculum. Found within the ‘Communication Competency’ is: “connecting and engaging with others”. This important competency is practiced throughout this unit, and this skill is directly taught to students at the beginning of the unit.

Students are asked to reflect on their progress of this skills as well. A full list of the curricular competencies that are embedded throughout this unit are listed within the unit plan on the ‘How Does This Unit Link to the BC Curriculum’ page.

Adapting to the Needs of the Students

Included is a few ‘Tips Pages’ to help the classroom teacher establish a positive learning environment and adapt the lessons to meet the needs of the individual learners in the classroom. A ‘Tips and Ideas for Structuring the Learning Environment’ page is one of the pages designed to be helpful to the classroom teacher who is setting up the environment and adapting for needs;

Planning a safe, calm, flexible, efficient instructional setting will make instruction and learning more effective. The goal is to match the level of physical stimuli with a student’s ability to make sense of stimuli from the environment. Students with FASD benefit from a structured, supportive approach to creating and modifying the learning environment.


The page provided in the unit plan for structuring the learning environment gives the classroom teacher a variety of tips and tricks for setting the students in the class up for success; These tips include: ‘Always modeling your expectations’, ‘Make sure that all materials are easily accessible when doing STEM activities’. One way to set students up for success is to: ‘place all of the materials that each group of students will need in a paper bag, so that the materials are already
prepped and ready to use’, and ‘focusing on cooperative and collaborative vs. competitive’ so that students can work on improving their individual skills instead of trying to win this will help to decrease student anxiety. Additionally, focusing on collaboration will help students get along and work together.

‘The Tips for Adapting the Unit Plan for Diverse Learners’ includes a variety of tips for adapting this unit including: ‘Using the posters and visuals provided to help teach the STEM steps, so that the students know what is coming next’, ‘have students who are not yet writing get help from a scribe, a computer, assistive technology, or let students have the freedom to draw their ideas and verbalize them to their partner and teacher’. Like students in most Canadian classrooms, students with executive functioning deficits will have a variety of different strengths and weaknesses and each student will mostly likely have different experiences and therefore, have different background knowledge. Some of the students will be able to read the directions, and some will struggle with reading, some of the students will be able to write out their ideas on the graphic organizers and some will need additional adaptations. This unit plan is intended to meet the needs of all of the students in all grade 4 British Columbian classroom. Additionally, this unit is targeted towards helping the students with executive functioning deficits therefore, flexibility and the ability to adapt each lesson to meet the needs of the individual learners in the classroom is a must.

Teachers need to think about the learners in their classrooms and address their individual needs to increase the chances of success for each individual student. This may mean pre-teaching concepts or teaching concepts a second time, providing immediate feedback to students, and adapting the lesson plans as needed (Bargerhuff, 2013). It may be beneficial to inform parents and guardians about the goals of the unit plan, get parents involved in the learning process if
possible, and make sure that parents and guardians are informed about their child’s progress and can give positive reinforcement when needed. Discussing the roles and expectations of students at school can be helpful to parents and guardians and can help lead into discussion surrounding routines that can increase compliance at home (Alberta Learning, 2004). It is vital that students understand that the school and the home are on the same page and the goals for the students are the same at both home and school. Teachers can accomplish “ongoing communication between the home and the school through phone calls, or by using a communication book between the school and home” (Alberta Learning, 2004).

**Direct teaching of Key Skills**

Structure, routines, and an emphasis on social emotional learning are all equally important to be able to meet the needs of all students, especially the ones struggling with executive functioning and social emotional learning. These activities include a role-playing game called ‘How can we disagree and still stay friends?’ This role-playing activity allows for students to practice self-talk and learn what to do in a variety of ‘what if…’ situations such as: what if my partner will not help? Talking through these ‘what if’ situations beforehand will decrease anxiety and let students know ahead of time what their options are for solving the social problem ahead of time before the situation happens. The goal of this is to increase confidence, decrease anxiety, and increase the rate of success with solving these social problems that may arise from working in a group. Also included is a perseverance wordle. This wordle is meant to teach students about perseverance and get students thinking about why it is important to not give up, to get their job completed, and how having perseverance is an important skill that will help them now and in the future. The ‘Leadership Qualities’ graphic organizer is one of the other activities included in this unit plan. The ‘leadership Qualities’ graphic organizer gets students thinking about the
qualities of a good leader and asks students to set a goal for how they can become a better leader. The ‘draw a picture of yourself being a good listener activity’ is designed to encourage positive self-thinking and positive self-talk which is emphasized by Alberta Learning (2004). Teaching positive self-talk strategies is essential for increasing student self-confidence and is a good strategy for encouraging students ‘to do the right thing’, by training them to talk to themselves and visualize themselves doing the right thing. Additionally, ‘The 5 Steps to Being a Good Team Member’ encourages students to think ahead of time of what it means to be a good team member and draw a diagram of 5 ways that someone could be a good team member. This might include doing your share of the work and being kind to others in your group etc. Students are also asked to reflect on why being a good team member is important. These activities are meant to be team building activities to set the tone and gain an understanding of how everyone should work together in a collaborate and respectful way. When the students are ready to start their STEM activities, the teacher needs to set up the STEM routine with the help of the ‘STEM Routine’ poster. “Teaching a routine effectively requires direct instruction, practice, and monitoring. Use clear and concise vocabulary. To avoid confusion, limit conversation during instruction and focus on essential information” (Alberta Learning, 2004). The included poster lists the 5 steps of the STEM routine. It is recommended that this poster is used to structure the lessons throughout the unit plan. Routines are important for students with executive functioning deficits, therefore this poster is critical to the success of the unit. It is highly recommended that teachers establish the routines and then stick with them, it is also recommended that teachers refer back to the poster to remind students of the established routines on a regular basis.

“Students with FASD need to know what is happening next, this decreases their anxiety which encourages success for all students (Alberta Learning, 2004). Also included is a poster that
clearly explains what STEM is. “STEM integrates science, technology, engineering, and math. STEM encourages deeper level thinking, hands on and experimental learning, and helps prepare students for real life problem solving and job-related skills”. This poster will be helpful in explaining to students what STEM is.

**The STEM Activities**

Each of the STEM building activities: the catapult, marble maze, the improving my community, and the STEM Bingo activities are all broken down into 2 day lessons. Each STEM building activity includes directions for each of the lessons. The first day of each of the STEM activities contains the planning and building process. Day 2 includes the testing and reflecting parts of the activity. Although it is recommended that each activity is to be completed in 2 days, all of the activities can be adapted to be stretched over more days if needed. All of the lessons contain clear directions including a list of materials, the goal of the activity, and the directions. Each activity also contains graphic organizers related to the STEM process. Graphic organizers are an effective way to teach organizational writing skills for students with learning disabilities according to a 2003 study on fifth grade students from Chicago, Illinois (Capretz, Ricker, & Sasak, 2003). “Self-assessment is a process by which a learner collects information about him/her self, and reflects on his/her learning” (Shatri & Zabeli, 2018). The STEM activities provided in this unit plan include: a build a catapult activity, a marble maze activity, a how can I improve my community activity, and lastly an activity where students can build anything they like with limited materials. Exposure to STEM from a young age is important for setting students up for a greater chance at a successful career in our changing economy. “Individuals who express an affinity for STEM and successfully pursue these subjects in secondary and post-secondary
education obtain a stronger position relative to the global economy and earn an advantage in the 21st century workforce”. (Bargerhuff, 2013).

**Student Reflection and Self-Assessment**

In this STEM based unit plan, students are asked to reflect on, set goals, and build upon their current skill level in the areas of: work ethic, ability to working collaboratively with others, and leadership skills. Students are asked to show improvement after each activity and set a goal for next time. According to a 2018 study completed in Turkey involving 725 students aged 12-18, “Students can improve their self-regulation skills through self-assessment” (Shatri & Zabeli, 2018). Two activities can be found at the end of the unit, that can be used any time throughout the teaching of the unit the activities are titled: ‘The Ticket out the Door’ which can be used as a check in, or a reflection at the end of each activity. The ‘STEM Problems and Emotions’ activity can be used as need, when students need to reflect on different feelings that may have come up while completing the STEM based activities found in this unit.
Chapter 4

Reflection and Conclusions

This chapter reflects on what I have learned throughout the journey of exploring the question: ‘what teaching resource would be useful for students who are impacted by FASD.’ To address this question, I researched the topics FASD, trauma, executive functioning, and social emotional learning. To address the need for more classroom resources for students with FASD who have also experienced trauma, I created a multi lesson unit plan titled: ‘Supporting Students with FASD and Trauma with the Help of STEM’. This unit plan is designed to help fill a need in special education by adding to the educational resources available for students who are struggling with FASD and trauma. As discussed in chapter 2, there is a need for further teacher and caregiver education in this area, and a need for more research and resources for supporting students with executive functioning deficits in the classroom.

What I learned
During my research on the topic of FASD and trauma, I learned an extensive amount about the damage that can be caused to the fetus by prenatal drinking. This learning includes the difficulty of diagnosing FASD, the lack of supports for teachers and caregiving of students with FASD, and what is currently available in terms of interventions for executive functioning deficits and social emotional learning in the field of special education. From the research on FASD and interventions to support students with FASD and trauma, I have come to the conclusion that students with FASD who have also been impacted by trauma need interventions to help them with executive functioning and social emotional learning.

Executive functioning and social emotional intelligence, are both extremely important skills that need to addressed with any student who is lacking in either of these areas. Executive functioning deficits affect planning, memory, the ability to pay attention, decision making, problem solving, and executive functioning supports emotional resiliency (Han, Helm, Lucha, Zahn-Waxler, Hastings, & Klimes-Dougan, 2016). Students who need support with social emotional learning are lacking the ability to decode social information. Students lacking social emotional learning have difficulty making and keeping peer relationships, solving social problem, self-regulating, and controlling impulses (McKown, Allen, Russo-Ponsaran & Johnson, 2013). Executive functioning and social emotional learning are key areas that students and adults need to be proficient with in order to lead healthy lives, have healthy relationships, and maintain jobs and careers. These two key areas are both deficits that many students who are struggling with FASD and trauma have, therefore the STEM based unit plan I have designed for grade 4 students who are struggling with FASD focus in on these two areas.

Student participating in this STEM based unit plan learn from a variety of different activities that target social emotional skills before they begin the STEM activities, and once the
students begin the STEM activities, they get to practice many skills such as: problem solving, being a good listener, how to disagree and still stay friends, and perseverance in a non-judgmental and encouraging atmosphere. After each of the STEM activities, students are asked to reflect on how the activity went. The focus on the reflection activity is not on whether or not the challenge was successful, but the focus is really on: how to work well with others, how to show kindness to others, making sure the student has done their share of the work, and not giving up even when the activity might be hard.

The most important thing that I have learned, not just through my research, but also by working with students who are struggling with FASD is to remember that each student is unique and not every student struggling with FASD will have the same strengths and weaknesses. After learning this, I realized that the unit plan that I would create needed to not only be highly structured to encourage success for all students, but the unit plan also needed to be highly adaptable to meet the needs of the individual learners in the classroom. Therefore, getting to know each learner is very important and finding out what their strengths and weaknesses are and finding how to best support each unique student is vital.

**The goal of the unit plan**

The unit plan was created based on the need for more educational resources for students with FASD, and created based on previous research in the field of special education on the topic of interventions for students with deficits typical of FASD and trauma such as: executive functioning deficits, social emotional learning needs, fine motor practice, and improvement in focus skills. The goal of creating a STEM based, ready to use resource that meets the outcomes for the grade 4 BC curriculum was successful. The unit plan contains a variety of STEM based activities including: building a catapult, building a marble maze, building a prototype of an
invention that will somehow help improve the student’s community, and more. Before students begin to build their STEM projects with partners or small groups, students will complete a variety of preparation activities that will prepare students for working cooperatively. These activities include a role playing activity called: ‘How can we disagree and still stay friends? A leadership qualities worksheet which includes a variety of different questions concerning the qualities of a good leader. Self-assessment and goal setting activities, these activities promote growth and reflection and these types of activities are embedded throughout the unit. Although this unit was not tested in any classrooms besides my own, this unit does meet the goal of adding to the resources in the field of special education for students who are struggling with FASD and trauma.

Limitations

This unit plan was designed for grade 4 students and it is based around the New BC Curriculum. This could be seen as a limitation as the unit plan was not created for all students who have FASD, but for a narrow group of students who are in grade 4 in the current BC education system. Many of these lessons were successfully used by me in my own grade 4/5 classroom during the 2017-2018 school year, the unit plan was not used, tested, or researched outside of my own classroom.

Implications of using this unit plan in the classroom

The activities in this unit plan were used by me and my 18 grade 4/5 students during the 2017-2018 school year. I tested the STEM routine and completed many STEM activities using the structured STEM routine found in the unit plan. I also reinforced the expectations of the routine with the visuals which can also be found in the unit plan. I planned STEM activities for Friday afternoons throughout the majority of the school year. My students, many of who had
difficulties with executive functioning and social emotional learning benefited from the activities. The lessons themselves ran smoothly most of the time. I had a few students who needed to get used to the routine and expectations, once this was established the activities usually ran smoothly. Students were able to bring the skills learned from the STEM expectations into other areas of the classroom. This group of students, including the students with higher needs became sufficient at AB partner talk activities and other small group activities which I believe is a reflection of the social emotional skills learned with the STEM unit.

The students with higher needs will need more monitoring, adaptations, or interventions with some of the activities. Simple reminders concerning problem solving, active listening, or time management may be necessary. Additionally, if the teacher predicts a conflict between students or student frustration is on the rise intervention or redirection may be needed. Therefore, teachers do need to make sure that the routines and structure of the activities are set up in a solid way, and teachers need to monitor all of the students and make sure that they are getting the interventions and adaptations that they need, and feel safe in the learning environment to make mistakes and learn and grow from them. Lastly, I recommend to teachers that they set students up for success especially in the beginning of the unit. One of the long term goals of the unit plan is for students to be able to work with any student in any setting, but students need to practice working with students that they get along with first. It is important that teachers choose the groups that students work in carefully, and make sure that in the first few group activities students practice their executive functioning skills and social emotional skills with other students who they feel comfortable with. Once they have practiced these skills with students that they feel comfortable with, then they can partner up with other students who they will also work well
with, but won’t be a trigger for their behaviours. Setting up the learning environment and maintaining the safely to learn in the established environment is key.

**Benefits of this Unit Plan:**

There are many benefits to students participating in the lessons within the unit plan: ‘Supporting Students with FASD and Trauma with the Help of STEM.’ This unit plan was specifically designed to help improve social emotional skills and executive functioning skills of students with FASD who have also been impacted by trauma, but the activities in this unit are adaptable enough that every student, in any BC classroom, would benefit from learning more about the themes and goals of this unit. The unit plan is matched to the outcomes found in the new BC curriculum and students who have participated in all of the lessons will have gained valuable experience working collaboratively, reflecting, being a leader, following directions, practicing time management, problem solving, practice fine motor skills, and setting goals.

Students are directly taught social emotional skills and then asked to practice these learned skills in a safe and inclusive way where they can practice solving real life problems. On day two of the STEM activities students are asked to test their prototype, and reflect or make improvements on their creations. Throughout this unit, students are given the opportunity to reflect on their work independently and work collaboratively with others. Experiencing success with collaborating and having the ability to reflect on your own work in order to learn, grow, and make improvements is a big life skill that all participating students will benefit from. As a result of the direct teaching of the social emotional lessons such as the ‘How to disagree and still stay friends’ and ‘Working together? How do we do that?’ and the executive functioning focused parts of this unit plan such as the problem solving, time management, and goal setting parts of the lessons, students will gain valuable life skills and practice using these new important skills in a structured way. The newly
found skills from the lessons, experiences, practice, and routines found within this unit plan will carry forward into other classroom subject areas, home life, and could become skills and work habits that could make the student more employable later on in life.

Conclusion

Throughout my journey in search of answering the question: ‘what teaching resources would be useful for students who are impacted by FASD’ I learned a considerable amount about how teachers can best support students with FASD who have also been impacted by trauma in classrooms. I was also reminded that all students are unique and all students have individual needs, but 2 areas that teachers can focus on to best support students with FASD who have been affected by trauma are: social emotional learning and executive functioning. ‘Supporting students with FASD and trauma with the help of STEM’ is a 43-page unit plan developed for grade 4 teachers to use in their classrooms to directly teach social emotional learning and executive functioning. Participating students will gain valuable knowledge about leadership skills including how to be a good listener, how to disagree and still be friends, how to work together cooperatively, and how to develop perseverance. The purpose of this unit plan is to allow students the opportunity to practice these new skills in a fun, hands on, and safe way. My hope is that this unit plan will help students gain and practice these valuable skills, and also help students gain the tools that they need to be successful in the classroom and beyond.
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Supporting Students with FASD and Trauma with the Help of STEM

By Jessicca Nielsen
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Why use STEM to teach: Executive Functioning and social emotional skills?

Students who are living with FASD, along with many other students in our classrooms may lack executive functioning and social emotional learning skills. Executive functioning is a group of skills that help to regulate working memory, cognitive thinking, and self control. Social emotional learning is the thinking and skills that help one control their emotions, build healthy relationships, set goals, and make good decisions.

STEM (Science, Technology, Engineering, and Math) careers are on the rise and the new BC curriculum recognizes the importance of STEM for all BC students.

STEM activities encourage working together, communication, decision making, creative thinking, creativity, and opportunities for reflection. STEM and social emotional learning can be taught together. This combination of learning activities can be taught together because STEM activities encourage practice with social emotional learning. Additionally, STEM opens the door for reflection, speaking and listening activities, working together, generating ideas, relationship building, and self regulation which are all areas that students with executive functioning and social emotional deficits need extra support understanding and practicing.
How does this unit link to the BC Curriculum?

This unit links to the grade 4 ‘Applied Design, Skills, and Technologies’ curriculum. Within this unit students are asked to design a prototype, and then build, test, and reflect upon their prototypes.

| Many of the core competencies are embedded within this unit: |
| Including: |
| Communication Competency Profiles |
| -Connect and Engage with Others |
| -Collaborate to plan, carry out, and review constructions and activities |
| -Explain/ Recount and Reflect on Experiences and Accomplishments |
| Creative Thinking Competency Profiles |
| -Novelty and Value |
| -Generating Ideas |
| -Developing Ideas |
| Critical Thinking Competency Profiles |
| -Analyze and Critique |
| -Question and Investigate |
| -Develop and Design |
| Personal Awareness and Responsibility Competency Profiles |
| -Self determination |
| -Self Regulation |
| -Well Being |
| Social Responsibility Competency Profiles |
| -Contributing to community and caring for the environment |
| -Solving problems in peaceful ways |
| -Building Relationships |

Along with many of the curricular competencies found in the grade 4 ADST BC Curriculum including:
- Students are expected to be able to do the following:
  - Define:
    - Choose a design opportunity.
  - Ideating:
    - Generate ideas and build upon the ideas of others.
    - Screen ideas against objectives and constraints
    - Choose an idea to pursue
  - Prototyping:
    - Outline a general plan, identify the tools and materials
    - Construct a first version of the product, make changes to tools, materials, and procedures as needed.
  - Testing:
    - Test the product.
    - Gather peer feedback and inspiration.
    - Make changes and repeat again until satisfied with the product.
  - Making:
    - Construct the final product and incorporate the planning stages.
    - Sharing
    - Reflect on their design thinking and processes, and their ability to work effectively both as an individual and cooperatively in a group.

The 3 Big Ideas found in the Grade 4 ADST curriculum are all reflected within this unit:
- Designs can be improved with prototyping and testing
- Skills are developed through practice, effort, and actions.
- The choice of technology and tools depend on the task.
Tips and Ideas for Structuring the learning environment:

- Make sure that all materials are easily accessible for the STEM activities. Students will need a variety of different materials. Place all of the materials that each group will need in a paper bag. This will save time and ensure that the groups can get started right away.

- Use the visual materials (posters, graphic organizers... act) provided to help support the directions.

- You know your students. Anticipate how they will react to trying something new and plan to support your students as needed.

- Always begin the lessons by reviewing the last day's materials.

- Set the mood with relaxing music and try to keep the learning environment as calm as possible.

- Ensure students have stopped what they are doing and they are fully listening before you give new instructions. You may want to establish a stop and listen to the teacher routine such as: a clapping pattern where the teacher claps and the students clap the pattern back and then look at the teacher.

- Write all important information on the board as a reminder to students. This includes the agenda for the lesson so that students know what to expect.

- Maintain the STEM challenge routines that you will establish during the first STEM lesson.

  - Focus on cooperative vs. competitive.

  - Use positive reinforcement.

  - Use timed timers to help structure the blocks of time.

  - Provide adequate supervision.

  - Maintain a positive classroom climate.
Tips for Adapting the unit for diverse learners:

- Make sure that all students know why they are learning about STEM and why they are learning about getting along with others. Students will be more likely to listen and participate if they know why they are learning this topic and why it is important.

- Use the posters and visuals provided to help teach the STEM steps and so that they know what is coming next. Some students may benefit from their own copy of the routines.

- Model your expectations.

- Have students who are not yet writing get the help from a scribe, use a computer or assistive technology, or the freedom to draw their ideas and verbalize them to their partner and teacher.

- You may need to reduce the work or divide the assignments into more manageable segments for some students.

- Allow more time for students who need it.

- Limit the sensory stimulation of the learning environment as much as possible. This includes:

  - Keeping noise in the learning environment to a minimum by ensuring the room is safe and calm at all times.
  - Keep distractions to a minimum.

- If possible choose a space that has low visual stimulus. This may mean clutter needs to be put away, classroom materials may need to be covered, and walls need to be bare to reduce the visual stimuli in the space.

- Establish and maintain a strong relationship between the home and the school. Make sure parents and guardians so that parents and guardians can continue the learning from the classroom at home, become involved in their child's learning, and help with positive reinforcement.
STEM Posters

What is STEM?

Science
Technology
Engineering
Math

STEM integrates Science, Technology, Engineering, and Math, and STEM encourages deeper level thinking, hands on and experiential learning, and helps prepare students for real life problem solving and job skills.

STEM is a terrific way to encourage and practice problem solving, listening, cooperation, and perseverance.

STEM Routine

1. Start your timer! You have 10 minutes of planning time.

2. Design team Work cooperatively With your group and design a prototype.

3. Test your prototype.

4. Think of ways to improve your prototype.

5. Now that the activity is over, reflect on your experience working with your group.

Engineering and the Designing Process

Did you ever wonder how a building got built? From idea to real building? This is a STEM Problem, here is the STEM Engineering and Designing Process:

- Brainstorm
- Draw up a plan
- Build a prototype
- Test the Prototype
- Redesign with improvements
What is STEM?

Science
Technology
Engineering
Math

STEM integrates Science, Technology, Engineering, and Math, and STEM encourages deeper level thinking, hands on and experiential learning, and helps prepare students for real life problem solving and job skills.

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Engineering and the Designing Process!

Did you ever wonder how a building got built from idea to real building?? This is a STEM Problem. Here is the STEM Engineering and Designing Process:

- Brainstorm
- Redesign with improvements
- Draw up a plan
- Build a Prototype
- Test the Prototype
STEM Routine

1. Start your timer! You have 10 minutes of planning time.

2. Design time! Work cooperatively With your group and design a prototype.

3. Test your prototype.

4. Think of ways to improve your prototype.

5. Now that the activity is over, self reflect on your experience working with your group.
Being a Good Team Member Activities
How do you be a good listener?

Draw a picture of how a good listener: looks and sounds...

Make sure to include at least 6 labels that describes how to be a good listener
How can we disagree and still stay friend?

**Directions:**

These role playing cards are meant to help students think about and talk through solutions to problems that may arise when they work in a group setting.

Have students act out these cards. Students can act out their role playing cards in small groups and then for the whole class. Students can then discuss what other choices they could have made during that situation and what possible outcomes each choice could lead to.

Or you could read out each card and brainstorm as a class what you should do in each situation? You could even have the students make up their own situations and then as a class talk through the solutions.
How can we disagree and still stay friend?

If you are having a disagreement with your friend, what can you do so that you and your friend still stay friends, and continue to work productively? Act out each of the situations so that you and your friend talk though the situation, everyone feels heard, and the outcome is positive.

Role playing cards:

Pretend you are building a robot out of lego and you have a great idea on how to make the arms move, but your partner thinks your idea will not work. What do you do?

Time is running out and your partner and you cannot agree upon what to build. You know your group need to submit your ideas to the teacher in 5 more minutes what do you do?
Role playing cards:

You are working in a group of three, and your 2 partners are best friends. They have taken over the project. What should you do?

Your group consists of you and your partner. Your partner is refusing to help. What do you do?

You have an idea, but your partner keeps talking over top of you, so you cannot get your ideas across. What do you do?
Role playing cards:

Your group is planning to build a parachute, and your partner can only talk about what was on TV last night. What do you do?

You and your partner are stuck. You both want to build a boat, but know your current idea won't work. You are both frustrated and not getting along. What do you do?
Working Together: How do we do that?

Name: ________________  Partner Name: ________________

1. Make a list of reasons why it is important to get along with your partner or group during STEM time.

   1. ________________  6. ________________
   2. ________________  7. ________________
   3. ________________  8. ________________
   4. ________________  9. ________________
   5. ________________ 10. ________________

2. Draw and label a picture of two students who are working cooperatively together during a STEM project.

3. What can you do to make sure you and your partner work together cooperatively?

   __________________________________________________________
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________
What is Perseverance?

Perseverance is when you continue using determination even when the work is hard.

Why do you think perseverance is important?

How do you think perseverance connects With STEM?

Can you think of a time when You had perseverance?
Name: _______________

What is Perseverance?
Wordle

Create a wordle to describe what perseverance.
What is a leader?

Qualities of a Strong Leader:

- Good communicator
- Honest
- Good intentions
- Reliable
- Empowering
- Good decision making skills
- Inspiring
- Creative
- Confident
- Accountable
- Positive attitude
- Easy to Talk to

Can you think of other qualities of a good leader?
Leadership Qualities

Why do you think leadership skills are important?

What leadership skills do you already have?

What are some of the qualities of a leader:

Set a goal to become a better leader. What kinds of leadership qualities do you want to gain? What are you going to do to gain these qualities?
5 Steps to Being an Excellent Team Member

In each box draw different examples of what it means to be an excellent team member and why it is important.

Name:
STEM Lessons

Build a Catapult
Build a Marble Maze
Improving My Community
STEM BINGO Activity
**What is a Catapult?**

A catapult is a devise used to fling or launch an object. The object is moved with the help of tension that is created and then released.

![Catapults](image1.jpg)

**What were catapults used for?**

During ancient and medieval times catapults were used during warfare to launch stones, spears, and other items towards the enemy.

**What were catapults traditionally made out of?**

Medieval catapults were usually made out of wood and rope.
Build a Catapult
Day #1

What you need:
- Popsicle sticks
- Elastic bands
- 1 spoon
- Pom pom, marshmallow, or other small item that can be launched using the catapult.

Goal:
To build a catapult using only the materials provided, and to work cooperatively with a partner or small group. The challenge is for students to build a catapult that can launch a pom pom at least 1 meter.

Directions:

Day #1

1. What is a catapult? As a class discuss what a catapult is. Use the poster provided to help explain what a catapult is.

2. Place students into small groups. Partners or groups of 3. For this first STEM challenge choose the groups ahead of time with students that you are confident will work well together.

3. Allow 10 minutes of planning time. Use a count down timer that students can see while they plan their designs. Have students plan out their designs on the ‘The Engineering: Design Process’ form. Before starting the timer remind students that the goal is to work together cooperatively. Ask students what working together cooperatively looks like, sounds like, and feels like. Make sure to praise the students who are working well together.

4. After students have their plans and the 10 minutes is up. Hand out the materials. Make sure to have the materials are prepped and counted ahead of time, so that students can get going right away. Make sure to reinforce the idea that there is no right or wrong way to build a catapult and that they are inventors experimenting with their own designs. The important part is working cooperatively which includes listening to your partners, accepting suggestions, and working together. Next, set 15 minutes on a timer that the students can see, and allow students to work cooperatively and build their catapults. Again, make sure to reinforce positive behaviours.
Build a Catapult
Day #2

What you need:
- Popsicle sticks
- Elastic bands
- Spoon
- Pom pom, marshmallow, or other small item that can be launched using the catapult.

Goal:
To build a catapult using only the materials provided, and to work cooperatively with a partner or small group. The challenge is for students to build a catapult that can launch a pom pom at least 1 meter.

Directions:
Day #2

1. All of the catapults should be built during day #1. Students should now be able to test their prototypes. When each group comes up to test their prototypes they need to be able to describe what they have built and how it works. Make sure to focus on the learning that has taken place, and that the goal is about cooperatively working together vs. winning the challenge.

2. Take 10 minutes for the group to come together. Each group member needs to think of one thing that they would do differently to improve their inventions for next time. They can write their one thing on the ‘The Engineering: Design Process’ form. (2 versions of this graphic organizer is provided. One with lines for writing and the other with large spaces for drawings).

3. Each partner needs to fill out a self evaluation concerning how they worked within their groups. They need to evaluate themselves using a happy, medium, and sad face and set a goal for how they are going to improve for next time.
Names: ____________________________

The Engineering Design Process

1. Ask: What is your STEM problem?
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________

2. Imagine: What could you do to solve your problem?
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________

3. Improve: How could your creation be improved?
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
The Engineering Design Process

1. Ask: What is your STEM problem?

2. Imagine: What could you do to solve your problem?

3. Improve: How could your creation be improved?
Names: ________________________

The Engineering Design Process

1. Ask: What is your STEM problem?

2. Imagine: What could you do to solve your problem?

3. Improve: How could your creation be improved?
Name: ________________

**STEM: Self Assessment:**

This is an opportunity for you to reflect on the work you did today as a team member! Truthfully answer each of the statements below by circling a face to show how you feel you worked and learned today.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Smiley Face</th>
<th>Neutral Face</th>
<th>Frown Face</th>
</tr>
</thead>
<tbody>
<tr>
<td>I listened to my partner or partners ideas...</td>
<td><img src="image" alt="Smiley Face" /></td>
<td><img src="image" alt="Neutral Face" /></td>
<td><img src="image" alt="Frown Face" /></td>
</tr>
<tr>
<td>I contributed my own ideas</td>
<td><img src="image" alt="Smiley Face" /></td>
<td><img src="image" alt="Neutral Face" /></td>
<td><img src="image" alt="Frown Face" /></td>
</tr>
<tr>
<td>I helped with the building of our creation.</td>
<td><img src="image" alt="Smiley Face" /></td>
<td><img src="image" alt="Neutral Face" /></td>
<td><img src="image" alt="Frown Face" /></td>
</tr>
<tr>
<td>My partner or partners and I worked together as a team.</td>
<td><img src="image" alt="Smiley Face" /></td>
<td><img src="image" alt="Neutral Face" /></td>
<td><img src="image" alt="Frown Face" /></td>
</tr>
</tbody>
</table>

My goal for next time is...

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
Build a Marble Maze
Day #1

What you need:
- 1 paper plate per group
- Straws
- Popsicle sticks
- Toilet paper rolls
- 1 marble

The goal:
The goal is for students to work cooperatively to successfully build a small marble maze using a paper plate, straws, popsicle sticks, or toilet paper rolls. Students can design their marble mazes however they would like, and can use as many of the materials listed as they would like.

Student must create a prototype and they must practice their cooperative working skills during this activity including listening, taking directions, and giving directions.

Directions:
Day #1

1. Discuss as a class what a marble maze is and the goal of a marble maze. When engineering a marble maze you need to create a device that a marble can roll through. You may want to discuss how a marble rolls you many need a surface that slants or the marble may need to roll from top to bottom.

2. Place students into small groups.

3. Allow 10 minutes of planning time. Use a count down timer that students can see while they plan their designs. Have students plan out their designs on the 'The Engineering: Design Process #2' form. With this form partner #1 and partner #2 build upon each other’s ideas to create a prototype.

4. After students have their plans and the 10 minutes is up. Hand out the materials. Make sure to have the materials prepped and counted ahead of time, so that students can get going right away. Make sure to reinforce the idea that there is no right or wrong way to build a marble maze. Next, Set 15 minutes on a timer that the students can see, and allow students to work cooperatively and build their mazes. Again, make sure to reinforce positive behaviours.
Build a Marble Maze
Day #2

What you need:
- 1 paper plate per group
- straws
- popsicle sticks
- toilet paper rolls
- 1 marble

The goal:
The goal is for students to work cooperatively to successfully build a small marble maze using a paper plate, straws, popsicle sticks, or toilet paper rolls. Students can design their marble mazes how they would like and can use as many of the materials listed as they would like. Student must create a prototype and they must practice their cooperative working skills during this activity including listening, taking directions, and giving directions.

Directions:
Day #2

1. On day #1 the each group of students created a marble maze. As a class discuss the creation process: What went well? What didn’t go as planned? How did you deal with the changes that happened?

2. Test the marble mazes. Have each group collect their marble maze and take turns testing the mazes. Make sure to reinforce the points: if the marble maze did not go as planned then take it as part of the learning and take note of the changes that many need to be made. They can write about how their invention could be improved in question #4 of their ‘The Engineering Design Process Form #2’.

3. Each partner needs to fill out a self evaluation concerning how they worked within their group. They need to evaluate themselves using a happy, medium, and sad face and set a goal for how they are going to improve for next time.
The Engineering Design Process #2

1. Ask: What is your STEM problem?

2. Imagine: What could you do to solve your problem?

   Partner #1 Idea
   Partner #2 Idea
   Partner #1 Idea
   Partner #2 Idea

3. Diagram of final prototype.

4. How can the prototype be improved?
**Name:** ____________

**STEM: Self Assessment:**

This is an opportunity for you to reflect on the work you did today as a team member! Truthfully answer each of the statements below by circling a face to show how you feel you worked and learned today.

| I shared with and I listened to my partner. | ![Smiley Face] | ![Neutral Face] | ![Sad Face] |
| I helped with the building of our creation. | ![Smiley Face] | ![Neutral Face] | ![Sad Face] |
| I helped with the testing of my group's creation. | ![Smiley Face] | ![Neutral Face] | ![Sad Face] |
| I thought of ways that my group's creation could be improved. | ![Smiley Face] | ![Neutral Face] | ![Sad Face] |

**My goal for next time is...**

________________________________________________________________________

________________________________________________________________________
Improving my Community
Day #1

What you need:
A variety of different building materials. These materials could be purchased from the dollar store (e.g. Popsicle sticks, cotton balls, or pipe cleaners), or they could be recycled materials (e.g. Empty boxes, toilet paper rolls...).

The goal:
The goal is for students to work cooperatively to successfully build a prototype of an invention that will somehow help their community in one way or another.

Directions:

1. Have a class discussion on the topic of what kinds of problems we have in our community. This could be surrounding the topic of recycling, garbage collection, vandalism, lack of affordable housing, clean water problems, lack of locally grown food... ect. Write down all of the ideas on the board.

2. Place students into small groups. Each group needs to choose one community problem that they are going to tackle.

3. Allow 15 minutes of planning time. During this time students will fill out the ‘An Invention to Improve my Community’ graphic organizer, and work together to design a prototype that will help improve their community in some way. Use a count down timer that students can see while they plan their designs.
Improving my Community
Day #2

What you need:
A variety of different building materials. These materials could be purchased from the dollar store (e.g., Popsicle sticks, cotton balls, or pipe cleaners), or they could be recycled materials (e.g., Empty boxes, toilet paper rolls,...).

The goal:
The goal is for students to work cooperatively to successfully build a prototype of an invention that will somehow help their community in one way or another.

1. Groups should have their plans and graphic organizers from the previous day. Now students can start building their prototypes. Hand out the materials that each group will need. Make sure to have the materials prepped and counted ahead of time, so that students can get going right away. Make sure to reinforce the idea that there is no right or wrong way to build and that they are using their creativity, problem-solving skills, and collaboration to design and build.

2. Next, Set 15 minutes on a timer that the students can see, and allow students to work cooperatively and build their catapults. Again, make sure to reinforce positive behaviours.

3. After all of the prototypes are built. Have each student fill out a ‘Improving my Community’ graphic organizer. This allows individual students to show their understanding of their prototype and how their invention would improve their community.

4. Have each student fill out a self-assessment concerning their part in the STEM activity.
Names: ____________________

1. Ask
   what is the improvement your community needs?

2. Imagine
   How could you help this need?

5. Improve
   How could your invention be improved?

An Invention To Improve My Community

3. Plan

4. Create
   Draw and label a diagram of your invention

Copied by Jessica Nolan 2018
Names: _____________________

**Improving My Community**

Draw a diagram of your invention:

Describe how the invention works:

Describe how the invention will make a difference in your community:

Draw a diagram of the invention helping people in your community.
Name: ______________

**STEM: Self Assessment:**

This is an opportunity for you to reflect on the work you did today as a team member! Truthfully answer each of the statements below by circling a face to show how you feel you worked and learned today.

<table>
<thead>
<tr>
<th>I listened during the class discussion.</th>
<th><img src="image" alt="Face" /></th>
<th><img src="image" alt="Face" /></th>
<th><img src="image" alt="Face" /></th>
</tr>
</thead>
<tbody>
<tr>
<td>I showed kindness to my team members.</td>
<td><img src="image" alt="Face" /></td>
<td><img src="image" alt="Face" /></td>
<td><img src="image" alt="Face" /></td>
</tr>
<tr>
<td>I helped with the building of our prototype.</td>
<td><img src="image" alt="Face" /></td>
<td><img src="image" alt="Face" /></td>
<td><img src="image" alt="Face" /></td>
</tr>
<tr>
<td>My partner or partners and I worked together as a team to complete the assignment.</td>
<td><img src="image" alt="Face" /></td>
<td><img src="image" alt="Face" /></td>
<td><img src="image" alt="Face" /></td>
</tr>
</tbody>
</table>

My goal for next time is...

__________________________

__________________________
STEM BINGO Activity

Goal:
This activity allows students to start from the materials and then use creativity and imagination to build an invention based on what they have.

Materials:
Students will need access to all of the materials on the BINGO card. Please note: All of the materials are easy to find. They are either recycled materials or can be found at your local dollar store.

Directions:

1. Place students in small groups.

2. Each group needs a bingo card, the inquiry sheet, and access to all of the materials on the Bingo Card.

3. Explain to students that each group will build some kind of useful prototype of their choice, but instead of starting with the goal, they will start with the materials and decide based on the materials that they have, what they want to build. Students will start with 5 materials or 4 if they choose a line with the free square. They must use all materials in their BINGO line in order to get a BINGO and be successful with the assignment.

4. Next, students will use the ‘STEM BINGO Inquiry’ sheet to show their planning. This includes the 3 potential ideas for what they might create, and what idea the group is going to commit to building, and lastly the reason why they choose that prototype.

5. Students will work as a team to collaboratively build their prototype.

6. Students will fill out a ticket out the door as a self assessment at the end of the assignment.
STEM BINGO Activity

Make sure you get a BINGO! You get a BINGO by using all of the materials in one row of this Bingo card to build your invention.

<table>
<thead>
<tr>
<th>Q-Tips</th>
<th>Pipe cleaners</th>
<th>Cotton balls</th>
<th>Large Box</th>
<th>Rock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Pasta</td>
<td>Pastic spoons</td>
<td>Pencil</td>
<td>Popsicle sticks</td>
<td>Bowl</td>
</tr>
<tr>
<td>String</td>
<td>Shoe Box</td>
<td>Free</td>
<td>Text books</td>
<td>Beads</td>
</tr>
<tr>
<td>Paper Plates</td>
<td>Socks</td>
<td>Paper</td>
<td>Cups</td>
<td>Folder</td>
</tr>
<tr>
<td>Cookie sheet</td>
<td>Yarn</td>
<td>Metal pots</td>
<td>Rope</td>
<td>Fork</td>
</tr>
</tbody>
</table>
STEM Bingo Activity Inquiry Sheet

Group members names:

Materials:

Make sure you get a BINGO by using all of the materials in one row of your Bingo card.

3 Ideas for inventions you might create:

- [ ]
- [ ]
- [ ]

What idea are you going to build? Why did you choose this idea?

- [ ]
- [ ]
- [ ]

What additional materials will you need?

- [ ]
- [ ]

Draw your invention and label what it does and how it works...
STEM Problems and Emotions

One problem I came across was...

This made me feel...

Fill the circle with a face that shows how you felt.

I solved this problem by...

This made me feel...

Fill the circle with a face that shows how you felt.