Mindful Transformations, More Than Meets The Eye

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The curriculum unit is recommended for:
Math 2, grades 8-10

Keywords: Math, geometry, transformations, mindfulness, anxiety, brain games, growth mindset, visual math, art

Teaching Standards: See Appendix I for teaching standards addressed in this unit.

Synopsis: Students will participate in mindful practices and develop a growth mindset through activities embedded in math lessons aligned to the North Carolina Math 2 standards. Students will answer questions about the properties of rigid and non-rigid transformations, justify whether two figures are congruent or similar, the connection between functions and transformations and the real-life relevance of transformations. Transformations is the first unit in NC Math 2. This unit should help teachers to create a routine to support students in developing a mindful practice and growth mindset in a project-based learning experience. The summative assignment for the curriculum unit requires students to create original journal entries based on their reflections through the learning process.

I plan to teach this unit during the coming year to 143 students in Math 2.

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Introduction

Rationale: "I was really good in math in 5th grade… then I got to middle school and they started putting letters with numbers and I was like why are we learning English in Math class," my student spoke frankly. As we continued to talk about her math journey, she described her experiences of success and failure, how the frequency of her success and failures changed over time, what the changes have done to her confidence in her knowledge and the adaptations she's made in order to continue to experience success. My conversation with this young lady and many other students like her is the inspiration that guided my approach to this unit. Specifically, I will focus on the mindful transformations students must embrace in order to increase confidence and find personal success in their math classes. However, this is not just math class… it really spills over into life!

Math...the name itself creates anxiety for many learners for various reasons. Some would even say math anxiety is hereditary. Actually, math anxiety is learned and nurtured through a fixed mindset. Caregivers will often say, "Oh, I was never good at math," as a reasoning for our student struggling. As a result, students may create a mental block towards the process of learning math. That is powerful! Mentally, we can shut down and not allow ourselves to experience new learning. Yet, with a shift in mindset we can experience and retain new learning. There is a delicate balance between acknowledging fears/concerns and encouraging repeated risk taking. Afterall, taking a risk means the learner could be wrong once or repeatedly wrong. I often remind my students, you are also taking the risk of being right repeatedly. Math has such a bad reputation as being hard and only meant for those inclined towards mathematical logical thinking. This unit will help all my students, whether in standard or honors, to understand their learning process better. My students will use this newfound self-awareness to be compassionate with themselves and others through the learning journey by avoiding judgement and embracing constructive feedback and self-reflection.

School/Student Demographics: Harding University High School (HUHS) is one of the high schools in the Northwest Learning Community, located in Charlotte, NC. The demographics of HUHS has significantly changed over the years. In 1957, it was one of the first public high schools to be desegregated. From 1992 until 2014-2015 school year, HUHS was known as Harding University High School of Math, Science, and Technology, with a magnet International Baccalaureate (IB) programme added in 1995. Currently, HUHS has a Title I designation and serves as a home base school with a magnet IB programme. According to the 2018-2019 state report card, Harding's student population has 60.4% African Americans, 32.4% Hispanic an 3.6% Asian. Students who are economically marginalized make up 51.7% of the student body and 15.9% of the incoming freshman are considered proficient and high school ready. The graduation rate is 55.6% and Harding has met academic growth in two of the past 5 years. With a total of 1,596 students, 143 students participate in Advance Placement courses, 214 students participate in the College and Career Promise initiative and 39 students participate in the IB programme[1].

HUHS states its mission "to capture the hearts and ignite the intellectual potential of all students through positive daily interactions and rigorous instructional practices that foster lifelong learning." It is in this context that I create my curriculum unit.

NC Math 2 is traditionally a sophomore course. HUHS tracks students into Honors and Standards courses. I have approximately 90 students in IB MYP Math 2 and 30 in NC Math 2. The differences between the standard and honors courses come in the form of additional content and depth of knowledge for each of the six units. NC Math 2 standards are rigorous as it requires students to move beyond identification to investigate and prove relationships. I believe all students will be able to access the objectives in my curriculum unit with the necessary scaffolding/extensions provided throughout the lessons. At the same time, I recognize my attempt to meet the educational and emotional needs of my students are constructed, or even guided, by my view of the world as much as it is by my interactions with my students and how I interpret or perceive their needs. Ideally, I want to provide both empathy and accountability to increase equity regardless of tracking or socio-economic status. I believe that I can do that by coaching my students to embrace mindfulness and understand growth mindset. I want them to be aware of their fears (without judgement) and still make the decision to persevere, make mistakes frequently, learn from those mistakes just as frequently, then, move forward.

Unit Goals:

1. The overarching goal of this unit is to engage students in mindful practices such as breathing, tapping and brain games to ground the work of building a mindful mathematical community. In this type of atmosphere, teachers can support students in a safe environment to explore open-ended problems designed to reinforce students' growth mindset.
2. In this unit, students will expand on standards studied in Math 8 and NC Math 1, an eighth and 9th grade course respectively, by exploring, applying and proving properties of transformations, functions, similarity and congruence. Based on prior knowledge students will be able to make sense of why rigid motions produce congruent figures and non-rigid motions produce similar figures. Then, students will interpret transformations as functions and apply function rules to geometric shapes. In this phase of the unit, students will experience quick "wins" through brain games and standards aligned visual math exercises based on prerequisite and current content. Once procedural skill and fluency is developed, the teacher can then leverage those "wins" to extend to application of transformations in art.
3. Students will use their art to explore, draw conclusions and prove the properties of transformations through inquiry-based reasoning. While inquiry promotes student engagement, it also creates anxiety. For that reason, students will learn how to cope ahead to manage anxiety and the initial failures related to exploring and practicing new content.
4. Students will also learn how to deal with struggle productively by partaking in a classroom culture that empowers students to collaborate and take responsibility for their own learning.

In this unit, teachers will employ AVID strategies, personalized learning and universal design principles to coach students through using peer and self-assessment feedback to assess their own learning in student-created and student-led learning teams. In the team, students will learn to frame, analyze and solve problems. Students will develop effective communication skills by understanding the processes needed to make connections and communicate sound reasoning.

Content Research

What is mindfulness? Mindfulness is being present, in the moment, and aware of the current experience, without judgement of yourself or the moment.[2] Acceptance and non-judgment, are important components to mindfulness, neither of which comes naturally in a world where much is labeled "good" or "bad." To make an informed decision, one needs to be both self-aware and reflective. Both are skills that are developed over time and the reason for the empowerment we feel as we get older.[3] The ultimate goal of mindfulness education is to help students achieve personal academic success. Educators hope to achieve this goal by teaching students to self-regulate. Self-regulation is a process in which one learns to manage their emotions, behaviors, and attitudes, in order to be in the mindset to learn content.[4]

Charlotte Mecklenburg Schools has joined many school districts in the implementation of a social emotional learning program. This is a significant acknowledgement and commitment to our students because 13–14% of young people experience a mental health problem in a 12-month period.[5] Teachers are facilitators of the program implemented in a 45-minute homeroom. Given a lesson plan and necessary materials, teachers are expected to walk through the lesson with students, adding personal stories where appropriate. As with other schools that have implemented a social-emotional learning program, there are issues with clarity of goals and facilitations of the lesson. Lack of clarity comes from teacher facilitators not having their own personal practice of mindfulness and no training about how to implement such a curriculum. [6]

On the other hand, experts agree that teachers should teach their content and be responsible for the social-emotional needs of their students. At the high-school level, teachers spend approximately 9 hours a week with their students. In those 9 hours, students will have life experiences that will affect their ability to focus, manage their emotions and move forward in a constructive way. A.H. Maslow developed a hierarchy of human needs (see figure 1).[7] The elements students need to survive takes precedence over elements that raise esteem in oneself like education.[8] When students are stressed, the effects can be debilitating at worse but will definitely have a negative effect on the brain. As a result, students experience academic and social difficulties when their most basic needs are not met. In order to ensure the best possible educational experience for our students, teachers must consider the consequences of stress on our students. Teacher training on mindfulness education and implementing a mindfulness curriculum can have a positive effect: managing emotions, increasing students' focus, attention and positive social interactions. [9]

Figure 1. A.H. Maslow hierarchy of human needs

The science - The amygdala is activated when it detects a threat. As a result, the amygdala cues the brain to go into a fight, flight or freeze mode. The stress hormone released is called cortisol. The hippocampus and the prefrontal cortex are the areas of the brain that are most affected by cortisol. Furthermore, the long-term effects of stress shrinks the neurons in the brain's frontal lobes, the area responsible for making decisions, planning, and regulating emotions. Ultimately, the capacity to learn and working memory is significantly reduced because of stress. In the same way, with the right interventions and coaching, the brain's prefrontal cortex can be trained to respond to stress by shifting to a calmer mindset.[10]

Something that relates to being mindful is mindset. Carol Dweck's research is centered around how students cope with failure. Her studies revealed that students' responses varied when faced with challenges: some students thrived while others shut down. Students that persevered through challenges had better outcomes than students that refused to work through or around the challenges. Dweck developed a spectrum for this variation in mindset. On one end of the spectrum, she called it a fixed mindset and on the other end, a growth mindset[11]:

> *Fixed mindset* is the belief that people are born with a fixed amount of intelligence and ability. People operating in the fixed mindset are prone to avoiding challenges and failures, thereby robbing themselves of a life rich in experience and learning.
>
> *Growth mindset* is the belief that with practice, perseverance, and effort, people have limitless potential to learn and grow. People operating in the growth mindset take on challenges with the understanding that making mistakes and failing are essential to growth.

Dweck concluded that mindset makes a significant difference in five situations: challenges, obstacles, effort, criticism and success of others. Which brings us to what a growth mindset looks like in school, an environment in which students are bound to experience all five situations. From the administrators on down to students, mindset affects the efficacy of an educational program. A fixed mindset administrator, educator or student approaches these situations as a personal attack or unchangeable. In contrast, your growth mindset administrator, educator or student tries to understand the problem and find a way to resolve it. Dweck also differentiates between a true versus false growth mindset. A false growth mindset is praising effort when the results of the effort were no achievement. Dweck believed praise should come from what improvement came from the effort.[12]

Growth mindset can have a positive compounding effect on students who wield this power if they are attending schools with growth minded administrators and educators. However, the power of the growth minded educator can be enough to make the difference. The attributes of a teacher with a growth mindset is action oriented, flexible, maintains high expectations, communicative, process-oriented, values mistakes, understands the difference between equity and equality and develops strong relationships. Growth minded teachers are curious, they focus on asking questions and supporting students in leading the way to solve problems. These teachers believe every student can learn with constructive feedback and positive reinforcement. Students feel comfortable asking and answering questions regardless of the risks of making mistakes. Mistakes are seen as opportunities to deepen understanding. Research says that teachers with a growth mindset coach their students to develop resilience, improve problem solving and achieve positive outcomes. For that reason, students that feel supported by their teacher and peers in their learning journey will take more positive risks over time.[13]

Growth mindset is a journey not a destination. True learning is uncomfortable. We all fall along the spectrum depending on the situation (see figure 2). Teachers can create an environment that helps students develop the growth mindset to learn through the confusion and discomfort. Teachers can praise the process when students make mistakes and normalize mistakes as a pathway to accuracy. Talking about the content and giving feedback without grades encourages students to reach learning goals, not a letter/number grade. Teachers should also promote a growth mindset via all media types, modeling growth minded self-talk in difficult situations and discussing how the brain works. The science behind this really does speak for itself.[14]

Figure 2. Growth mindset spectrum

The science - The brain is a malleable organ for our entire lives, not just as a child… go figure, it is not fixed! Neuroscientists call it brain plasticity, which means the brain continues to change over time. When we learn something new our mind tries to resist the confusion; however, research says this feeling of disequilibrium is when true learning happens. The prefrontal lobe is

responsible for intentional actions like creativity and making decisions. It is also the area that teachers help to develop by allowing students to participate in higher order thinking. When students are challenged, the amygdala evaluates the new stimulation as a threat based on past experiences. Once the amygdala is calmed, engagement and self-regulation triggers various parts of the brain such as the occipital lobe (visualization), thalamus and prefrontal lobe (memory). In the very same moment, neurons are developed, the myelination sheaf thickens, and serotonin is stimulated, resulting in positive feelings.[15]

Learning, mindfulness and growth mindset happens because of strong relationships with students. Educators feel the urgency to cover the content in its entirety to ensure students are prepared to take state exams. Some educators feel this leaves little time to develop meaningful relationships with students. However, the North Carolina Teacher Evaluation Tool holds us accountable for both positive relationships with students and student achievement.[16] Relationships are not easy to maintain. Nevertheless, the work we do as educators requires strong relationships to increase efficacy. Here are some questions to consider as we examine our student relationships:[17]

- Do I greet the student by name each day?
- Do we talk about non-academic as well as academic topics that interest the student?
- Does the student know I care? Would the student describe our relationship as positive?
- When the student has difficulty, do they know I will work to help?
- Do the student and I laugh together?
- Does the student know who I am beyond the classroom?
- Do I know who the student is beyond the classroom?
- Does the student have evidence to track their progress in my class?
- Does the student think I believe they are smart?

Even with strong relationships, some students will still avoid challenges. Choice does not empower all students. Some students are overwhelmed by the vast number of choices. In fact, some students would rather be micromanaged and given explicit directions. If the students are not given directions explicitly, their behavior can look like apathy and frustration. The fact that the student is unable to make a decision reinforces their insecurities because they lack a sense of self-awareness or self-reflection. As we learned earlier, this can and will change over time especially in a classroom environment that supports mindfulness and growth mindset.[18]

Another obstacle faced by math educators is math anxiety. Math anxiety is an emotional and physical response related to doing mathematics. Students develop anxiety for various reasons including environmental, attitudes toward math, low self-esteem or learning styles. Whatever the reason, anxiety comes from the inability to self-regulate emotions. Math anxiety peaks in the 9th and 10th grade preventing students from excelling in higher level math courses.[19] Specifically, anxiety is more prevalent amongst higher achieving and female students. Math facts are held in working memory. When students experience stress, the working memory is blocked and students are unable to access information that they know. If this happens repeatedly, especially during testing, students develop anxiety. Anxiety leads to low confidence in a student's ability to do and comprehend math content. Consequently, anxiety is the reason we lose the interest of students in math. Students develop a fixed mindset as it relates to math.[20]

Growth mindset, mindfulness and building meaningful relationships with students in a math class creates a unique opportunity to bring students back into the fold of studying and excelling in the field of mathematics. When students experience authentic assessments with immediate feedback, an opportunity to reflect on their learning with peers and growth mindset messaging, they will opt for the growth mindset path in order to reach their learning goals. We want students to think they can do and understand math. In this environment, self-confidence replaces anxiety.[21] This is the reason we need this curriculum unit.

Instructional Implementation

As the first topic in NC Math 2, it is imperative this unit includes practices that ground the work of building a mindful mathematical community. Students will engage in mindful practices such as breathing, tapping and brain games. After each activity, students will debrief and reflect on their practice using all 5 senses and how the mindful practice can be implemented in other areas of their lives. At first, students may be reluctant because they are hypersensitive to their surroundings and what their peers may think. Eventually, students will not worry about what others think and will follow your lead because they trust you. It is a learning process. The time may need to be adjusted to build up to 3-4 minutes.

Mindful Practices - Breathing: Leaves on Streams

Students will let go of negative thoughts by separating themselves from those thoughts instead of engaging in them or making decisions based on them. This is called cognitive defusion. A benefit of cognitive defusion is it allows students to pause and consider their thoughts as passing through rather than facts. It is a good way to reduce negative feelings and belief in negative self-talk. There is an MP3 provided which includes visualization of leaves flowing on a stream (see *Appendix II: Lesson Resources)*. Every thought that comes to mind both positive and negative must be cognitively defused. If visualizing leaves is difficult for students, have them imagine anything that flows past them and does not come back such as cars, birds, etc. It is important to remind students to not worry or judge wanderings of their thoughts, teach them how to self-talk and bring their thoughts back to meditation. This activity will take 10 minutes with 3-4 minutes of meditation and 6 minutes to debrief.[22]

Mindful Practices - Breathing: Counting Breaths

Students will incorporate a mental cue to focus on breathing by counting the number of breaths. This technique is especially useful with students who have very busy minds and need to be released from ruminating on stressful events. It is important to remind students to not worry or judge wanderings of their thoughts, teach them how to self-talk and bring their thoughts back to meditation. An example of a breath count exercise is 4-7-8. Student will start by sitting up straight in a comfortable position. Next, place the tip of the tongue on the ridge of the gums, just behind the upper front teeth. Expand the diaphragm and slowly inhale through the nose for a count of 4. Hold your breath for another count of 7. Open your mouth slightly, keeping your tongue in place, and exhale for a count of 8. Repeat this cycle four times. This activity will take 10 minutes, 6 minutes of meditation with 4 minutes to debrief.[23]

Mindful Practices - Tapping: Emotional Freedom Techniques (EFT)

Tapping is based on the principles of ancient Chinese acupressure and contemporary psychology. Students will use their fingertips to tap 5-7 times on each of the 9 meridian endpoints: top of head, eyebrow, side of eye, under eye, under nose, chine, collar bone, under arm, and karate chop. At the same time, they will focus on negative emotions or physical sensations to calm the brain. A tapping sequence includes identifying the problem and determining how you feel about it. Students will start with a statement acknowledging their thoughts and concerns, then follow up with affirmations. It is important to remind students to not worry or judge wanderings of their thoughts. When tapping we are using self-talk to bring their thoughts back to meditation. This activity will take 10 minutes, 6 minutes of meditation with 4 minutes to debrief.[24]

Mindful Practices - Brain Games: Visual Dot Number Talk

Dot card number talks are short number sense activities that reveal creativity in math thinking. It also lets students see that math is visual and there are many ways of seeing math. This is a great introductory math game because it brings out the elements you want to see in the classroom everyday: speed at which students engage in problem solving, different ways of seeing and solving the problem, students taking the risk to talk about their findings as a whole group. The teacher will show a card with dots on it arranged in some pattern and describe to students that they will see the collection of dots quickly flashed on the screen. Afterwards, students will be asked how many dots are there and how they view the dots. A video of how this activity is implemented can be found in *Appendix II: Lesson Resources*. This activity will take 10 minutes.[25]

All the activities above will be completed in whole groups as a warmup. The debriefing can happen in a journal, in small groups or as a whole group. Below is a list of routine prompts for students to consider in the debriefing. Please provide sentence frames to learners that need the support.

1. Was it difficult to focus today? What was holding you back? Make a supportive statement to yourself. Repeat the statement verbally or in writing several times.
2. How do you feel? Consider how you feel before, during and after the mindful practice. Consider any triggers for strong emotions and problem solve through it. How can you cope ahead to manage those feelings?
3. Where in your body do you feel your feelings? Sometimes, we can feel our feelings in our stomach, chest, on our face or in your neck.
4. How has this mindful experience changed you? Do you see your perseverance through the experience? Who would you talk to about this? Why would you share it with this person?
5. What can you let go of and move forward in a positive healthy direction? Are you afraid to let go of it? Why? Letting go can be easy or it can take an enormous amount of courage and conviction.
6. What did you discover about yourself through the “letting go” process? How do you feel about this new sense of self-awareness?

7. Describe your support system. Celebrate the strength, resources and support you have around you?
8. Make a thought shifter list. This is a list of thoughts, memories, intentions, or affirmations that bring you joy and laughter. Does thinking about your list change your perspective when dealing with difficult moments and emotions?

Additional teaching strategies will include instructional videos embedded in EdPuzzle to view prior to attending class and a lesson launch to make content information comprehensible for all learners. EdPuzzle allows teachers to add questions to the video to assess student's understanding. The data can be used to design the lesson launch. Lesson launches will include opportunities for students to read, listen to peers and discuss vocabulary, contradictory statements, classifications and/or patterns. A lesson launch can assess prior knowledge and/or build background knowledge. Possible examples for a launch are an anticipation guide, philosophical chairs, or a discovery activity on Desmos.com. Launches may last between 10-40 minutes depending on the topic. After the launch, students will complete a self-paced choice board independently with opportunities for collaboration, reflection and connections to mathematically inspired art created by M.C. Escher, a Dutch graphic artist.

Lesson 1: Rotational & Reflection Symmetry

Objective: Students will determine if figures have rotational or line symmetry.

Warm Up: Mindful Practices - Tapping: Emotional Freedom Techniques (EFT)

Students will start with a statement acknowledging their thoughts and concerns, identifying the problem and determining how they feel about it. Then they will began to repeat this affirmation.

> ***Affirmations for Self-Confidence and Self-Belief:***
> – Fear is only a feeling; it cannot hold me back.
> – I know that I can master anything if I do it enough times.
> – Today I am willing to fail in order to succeed.
> – I believe that I have the strength to make my dreams come true.
> – I'm going to relax and have fun with this, no matter what the outcome may be.
> – I'm proud of myself for even daring to try; many people won't even do that!
> – Today I put my full trust in my inner guidance.
> – I grow in strength with every forward step I take.
> – I release my hesitation and make room for victory!
> – With a solid plan and a belief in myself, there's nothing I can't do.[26]

Assessment 1: Journal prompt: Describe your support system. Celebrate the strength, resources and support you have around you?

Activity 1: Lesson Launch

Students will determine symmetry in their own body. Then they will consider a collection of images (shapes, letters, buildings, etc.) with reflection symmetry. Reflection/line or "mirror"

symmetry are used interchangeably. Symmetry may be background knowledge for most students as it is introduced in the first grade. This topic is revisited throughout elementary and middle grade math. Then, the teacher will present a collection of images no line symmetry but there is rotational symmetry. Teacher will pose the question “Does the image have line symmetry?” Once the teacher receives a negative answer or clarifies the answer is negative, the teacher should have students consider a rotation of the image around the center. Ask students, “Does it look the same as the original image?” Explain to students that 360 degrees is a full rotation, and we have rotational symmetry when the turn is less than a full rotation. Once students recognize a few figures with rotational symmetry only, the teacher should define rotational symmetry explicitly, including how to calculate the order and angle of rotation. Now, present students with a collection of images that have line and rotational symmetry or asymmetry. Student will compare reflection and rotational symmetry as a discussion board prompt. Provide sentence frames for students that need guidance with starting their explanation.

Possible Sentence Frames:

When I think of reflection symmetry, I think of…
When I think of rotation symmetry, I think of…

Activity 2: Processing

Students will complete a choice board with two options to check for understanding. The first option is a gallery walk with a collection of real-world shapes. Students will classify real-world shapes as asymmetrical or reflection symmetry or rotational symmetry and angle of rotation. Then reflect on the relationship between the regular figures and their order and angle of rotation. The second option is a letter explaining to a famous person the symmetry of regular polygons starting with a triangle to a decagon. Then reflect on the relationship between the regular figures and their order and angle of rotation. Digital tool may be provided to assist students in visualizing the increment of rotations (*see Appendix II: Lesson Resources*).

Activity 3: Application

Teacher will show a video explaining the contribution of M.C. Escher to the field of art and math (*see Appendix II: Lesson Resources*). Students will begin their project by selecting or designing an asymmetrical image for their M.C. Escher inspired artwork (*see Appendix V: “Escher”esque Project*). Inspire students by calling their design their business logo or a tattoo. Students will login with their google account, insert the image into the Desmos graphing calculator and create a table to model the points around the perimeter of the image. This will be labeled the preimage. Then, students will use google spreadsheet to create a table with the preimage points in the first columns. A video is provided for support (*see Appendix II: Lesson Resources*). Students must save and name their Desmos file to continue work.

Lesson 2: Transformations

Objective: Students will use coordinates to develop function rules modeling transformations, line reflections, and rotations and size transformations centered at the origin. Students will generate a two-variable function to describe each transformation. Students will recognize that the domain of

a transformation is the set of coordinates of the preimage and the range of a transformation is the set of coordinates of the image.

Warm Up: Mindful Practices - Brain Games: Visual Dot Number Talk

The teacher will show a card with dots on it arranged in some pattern and describe to students that they will see the collection of dots quickly flashed on the screen (*see Appendix II: Lesson Resources*). Afterwards, students will be asked how many dots are there and how they viewed the dots. Teacher will capture student answers at the board. Encourage to students to share their answer even if it is slightly different from another student's contribution. [27]

Assessment 2: Journal prompt: Was it difficult to focus today? What was holding you back? Make a supportive statement to yourself. Repeat the statement verbally or in writing several times. Use this opportunity to explain to students that some problems require thinking outside of the box while others may be straightforward. Attempt the obvious answer first based on comprehension of the information. Everyone processes and applies information based on how sensical it is to the individual. Mistakes are an opportunity to learn and grow.

Activity 1: Lesson Launch

Students will complete Polygraph: Transformations, a Desmos activity (*see Appendix II: Lesson Resources*) in which students will review vocabulary terms: translation, dilation, rotation and reflection. Teacher may provide question stems to facilitate and encourage students to use precise academic language. Then, teacher will pause and guide a discussion about the affects each transformation has on the coordinates. Use the pattern to develop a verbal function rule for various types of singular transformations. Teacher will explicitly translate each verbal function rule into a mathematical function rule. Students will write function rules for images and verbal descriptions. Teachers should explicitly make the connection between domain/primage/input and range/image/output.

Activity 2: Processing

Students will complete a choice board with two options to check for understanding. The first option is students will create a one-pager in which they create and write 4 function rules, one of each type of transformation and apply the rules to an asymmetrical shape (*see Teacher Resources*). Then reflect on the relationship between the math operations/patterns used to write the function rules. The second option is to create a video in which they create and write 4 function rules, one of each type of transformation and apply the rules to an asymmetrical shape. Then reflect on the relationship between the math operations/patterns used to write the function rules. Students may collaborate on this activity but should have their own rules.

Activity 3: Application

Students will apply 4 transformation rules, one of each type, to their asymmetrical image for their M.C. Escher inspired artwork (*see Appendix V: "Escher"esque Project*). Students will show their work in the spreadsheet created in Lesson 1. Students will paste the tables from the

spreadsheet in Desmos graphing calculator. A video is provided for support (*see Appendix II: Lesson Resources*). Students must save and name their Desmos file to continue work.

Lesson 3: Properties of Transformations

Objective: Students will use coordinates to investigate properties of figures under one or more rigid transformations or under similarity transformations. Students will determine which transformations produce congruent or similar figures.

Warm Up: Mindful Practices - Breathing: Leaves on Streams

Students will let go of negative thoughts by separating themselves from those thoughts instead of engaging in them or making decisions based on them. There is an MP3 provided which includes visualization of leaves flowing on a stream (see *Appendix II: Lesson Resources)*. If visualizing leaves is difficult for students, have them imagine anything that flows past them and does not come back such as cars, birds, etc. It is important to remind students to not worry or judge wanderings of their thoughts, teach them how to self-talk and bring their thoughts back to meditation.[28]

Assessment 3: Journal Prompt - How do you feel? Consider how you feel before, during and after the mindful practice. Consider any triggers for strong emotions and problem solve through it. How can you cope ahead to manage those feelings?

Activity 1: Lesson Launch

Teacher will lead a discussion using Philosophical Chairs (*see Appendix III: Philosophical Chairs*). Students will complete a 5-minute Quick write analyzing 4 graphs, each representing one of the 4 types of transformations. The teacher can give the students the freedom to write anything they notice about the shapes or provide the following prompts:

1. A side of the preimage and its corresponding side of the image under a translation are parallel.
2. A side of the preimage and its corresponding side of the image under a dilation are parallel
3. The ratio of the side of the preimage and it corresponding side of the image under dilation is equal to the scale factor of the dilation.
4. Under a dilation the ratio of the distance from a point on the preimage to the center and the distance from a point on the image to the center (0,0) is equal to the scale factor of the dilation.
5. Under a rotation the distance from a point on the preimage to the center and the distance from a point on the image to the center (0, 0) is equal in measure.
6. The midpoint of the line segment from a point on the preimage to its corresponding point on the image under a reflection is on the line of reflection
7. The line segment from a point on the preimage to its corresponding point on the image under a reflection is perpendicular to the line of reflection.

Students will consider contradictory statements about the properties of figures under one or more rigid transformations or under similarity transformations.

Activity 2: Processing

Students will be broken into 7 groups and work collaboratively with defined roles to complete a Jigsaw activity (*see Appendix IV: Jigsaw – Properties of Transformations*) in which they prove the properties of figures under one or more rigid transformations or under similarity transformations. Students will use the distance, slope, and midpoint formulas to justify the properties. Students will regroup and share the conclusion and tools of investigation with their home group.

Activity 3: Application

Students will analyze the 4 transformation rules, one of each type, to their asymmetrical image for their M.C. Escher inspired artwork (*see Appendix V: "Escher"esque Project*). Students will show their work using the distance, midpoint, and slope formulas to prove the properties of figures under one or more rigid transformations or under similarity transformations.

Lesson 4: Compositions

Objective: Students will explore the concept of function composition using successive application of two transformations.

Warm Up: Mindful Practices - Breathing: Counting Breaths

Students will incorporate a mental cue to focus on breathing by counting the number of breaths. Remind students to not worry or judge wanderings of their thoughts, teach them how to self-talk and bring their thoughts back to meditation.[29]

Assessment 4: Where in your body do you feel your feelings? Sometimes, we can feel our feelings in our stomach, chest, on our face or in your neck. Teacher can give a poll to capture responses and it will allow students to see they are not alone.

Activity 1: Lesson Launch

Students will determine the sequence of transformations for a given image visually. Teacher can scaffold by reminding students of the properties of the transformations, so students know what patterns to observe (see *Lesson 3: Properties of Transformations*, Activity 1). Students will describe the transformation verbally and write the function rule for each transformation. The teacher will explicitly define composite functions and teach how to compose the two function rules. Teacher will emphasize the importance of the order of transformations. Students will consider how this affects the domain and range of the composite function. Students will also determine which properties are preserved under two or more rigid and non-rigid transformations. As an extension, students can consider how to create singular transformations with a composite function and vice versa.

Activity 2: Processing

Students will complete a choice board with two options to check for understanding. The first option is to write out steps to creating a composite rule and how to apply it to an asymmetrical shape with examples. Then reflect on the relationship between the math operations/patterns used to write the function rules. The second option is to create a video in which they are creating a composite rule and how to apply it to an asymmetrical shape with examples. Then reflect on the relationship between the math operations/patterns used to write the function rules. Students may collaborate on this activity but should have their own rules.

Activity 3: Application

Students will write a composite rule combining all 4 types transformation rules, one of each type, to their asymmetrical image for their M.C. Escher inspired artwork (*see Appendix V: "Escher"esque Project*). Students will show their work in the spreadsheet they began completing in Lesson 1. Students will paste the tables from the spreadsheet in Desmos graphing calculator. A video is provided for support (*see Appendix II: Lesson Resources*). Students must save and name their Desmos file.

Students will finalize project by gathering all of the work completed over the last 4 lessons into a presentation of their choosing: video, book, paper, etc. Students will reflect on math content and the process of the project. Teacher will use a rubric to evaluate the work students submit on the M.C. Escher project (*see Appendix V: "Escher"esque Project*). Providing timely feedback is essential in order for students to analyze and fix their work.

Appendix I: Teaching Standards

Standards for NC for Math 2

NC.M2.F-IF.1: Extend the concept of a function to include geometric transformations in the plane by recognizing that:

- the domain and range of a transformation function f are sets of points in the plane;
- the image of a transformation is a function of its preimage.

NC.M2.F-IF.2: Extend the use of function notation to express the image of a geometric figure in the plane resulting from a translation, rotation by multiples of 90 degrees about the origin, reflection across an axis, or dilation as a function of its preimage.

NC.M2.G-CO.2: Experiment with transformations in the plane; represent transformations in the plane; compare rigid motions that preserve distance and angle measure (translations, reflections, rotations) to transformations that do not preserve both distance and angle measure (e.g. stretches, dilations). Understand that rigid motions produce congruent figures while dilations produce similar figures.

NC.M2.G-CO.3: Given a triangle, quadrilateral, or regular polygon, describe any reflection or rotation symmetry i.e., actions that carry the figure onto itself. Identify center and angle(s) of rotation symmetry. Identify line(s) of reflection symmetry. Represent transformations in the plane.

NC.M2.G-CO.4: Verify experimentally properties of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

NC.M2.G-CO.5: Given a geometric figure and a rigid motion, find the image of the figure. Given a geometric figure and its image, specify a rigid motion or sequence of rigid motions that will transform the pre-image to its image.

NC.M2.G-CO.6: Determine whether two figures are congruent by specifying a rigid motion or sequence of rigid motions that will transform one figure onto the other.

NC.M2.G-SRT.1: Understand similarity in terms of similarity transformations. Verify experimentally the properties of dilations with given center and scale factor:

- When a line segment passes through the center of dilation, the line segment and its image lie on the same line. When a line segment does not pass through the center of dilation, the line segment and its image are parallel.
- Verify experimentally the properties of dilations with given center and scale factor: The length of the image of a line segment is equal to the length of the line segment multiplied by the scale factor.
- The distance between the center of a dilation and any point on the image is equal to the scale factor multiplied by the distance between the dilation center and the corresponding point on the pre-image.
- Dilations preserve angle measure.

Appendix II: Lesson Resources

Unit 1 Project: “Escher”esque - Video Playlist to model each phase of the project:
https://www.youtube.com/playlist?list=PLSX7wcv-LOpwdPPFaFXvw8YHST3oCz7QM

Leaves on a Stream MP3
https://positivepsychology.com/wp-content/uploads/Leaves-on-a-Stream.mp3

Visual Dot Number Talk
“Jo Teaching a Visual Dot Card Number Talk.”https://www.youcubed.org/resources/jo-teaching-visual-dot-card-number-talk/

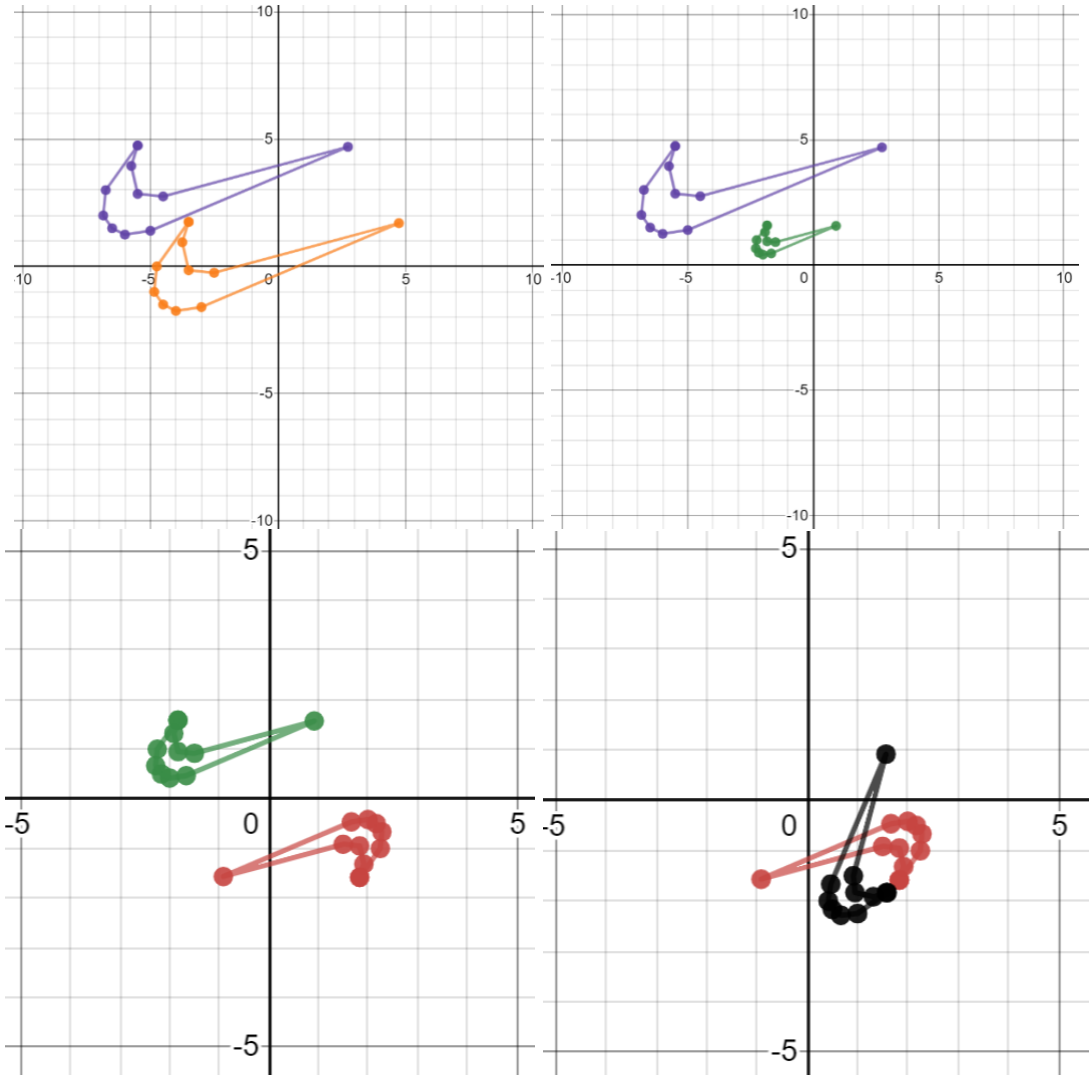
Polygraph: Transformations, a Desmos activity
https://teacher.desmos.com/polygraph/custom/560c53f5441172070b26220a

Artist M.C. Escher spent a lifetime distorting perspective
https://youtu.be/SaFCHXQVhFI

Interactive Math: Symmetry
https://www.interactive-maths.com/symmetry.html

Appendix III: Philosophical Chairs

Students will complete a 5-minute Quick write analyzing 4 graphs, each representing one of the 4 types of transformations.



The teacher can give the students the freedom to write anything they notice about the shapes or provide the following prompts:

1. A side of the preimage and its corresponding side of the image under a translation are parallel.
2. A side of the preimage and its corresponding side of the image under a dilation are parallel

3. The ratio of the side of the preimage and it corresponding side of the image under dilation is equal to the scale factor of the dilation.
4. Under a dilation the ratio of the distance from a point on the preimage to the center and the distance from a point on the image to the center (0,0) is equal to the scale factor of the dilation.
5. Under a rotation the distance from a point on the preimage to the center and the distance from a point on the image to the center (0, 0) is equal in measure.
6. The midpoint of the line segment from a point on the preimage to its corresponding point on the image under a reflection is on the line of reflection
7. The line segment from a point on the preimage to its corresponding point on the image under a reflection is perpendicular to the line of reflection.

Appendix IV: Jigsaw activity

Explain to students that they have home group and a jigsaw group. Tell them that they will work with their jigsaw group to become experts on one of the questions, and in order to do, that they will have to temporarily leave their home group and join their jigsaw group. After the question is investigated with their jigsaw, students will return to their home group.

Divide class into 7 groups, one group for each jigsaw piece of the puzzle listed below.

1. A side of the preimage and its corresponding side of the image under a translation are parallel.
2. A side of the preimage and its corresponding side of the image under a dilation are parallel
3. The ratio of the side of the preimage and it corresponding side of the image under dilation is equal to the scale factor of the dilation.
4. Under a dilation the ratio of the distance from a point on the preimage to the center and the distance from a point on the image to the center (0,0) is equal to the scale factor of the dilation.
5. Under a rotation the distance from a point on the preimage to the center and the distance from a point on the image to the center (0, 0) is equal in measure.
6. The midpoint of the line segment from a point on the preimage to its corresponding point on the image under a reflection is on the line of reflection
7. The line segment from a point on the preimage to its corresponding point on the image under a reflection is perpendicular to the line of reflection.

Appendix V: "Escher" esque project written by Baria Jordan and Kenya Lawrence

"Escher"esque Tattoos

Objective: To create an Escher inspired design with all four types of transformations made by any composition from an *original* preimage.

Standards Assessed

- I can translate, rotate, reflect, and dilate geometric figures on the coordinate plane.
- I can determine coordinates for translated, rotated, reflected, or dilated figure without graphing.
- I can identify and use transformations to create new images.
- I can identify and write rules for transformations that will map an object back onto itself OR map one object onto another.
- I can write transformations in coordinate notation.

Final Project Submission

Your final project submission should include each component below. You may choose how to fulfill the requirement for the final submission. Think outside the box!

PLEASE CHECK IN WITH YOUR TEACHER ONCE YOU'VE COMPLETED EACH COMPONENT

1. Original Design - Your logo should be *hand drawn* on some graph paper. Your logo should not have any rotational or reflection symmetry. All details should be present in this initial drawing. This is the picture you originally choose as your base and will be your original domain. You should then draw a set of axes and label a minimum of 10 coordinates along the perimeter of your preimage to have an outline when the dots are connected. Each coordinate needs to be labeled with a letter.

2. Mathematical Description - a detailed math description that must include a minimum of 10 original points and image points for each transformation made. This description should include the rules you are using written in function notation, the preimage coordinates in the same order of the desmos table from the next component and each transformation's output coordinates. Here is an example to help. (*Use cheat sheet for rules*)

3. Graphed Outlines - Once you've determined the coordinates of each of your transformations in the mathematical description component, you'll input them into a table on desmos.com. Each new image should be a different color and there should be a minimum of 5 outlines.

4. Final Canvas - your final drawing with all shading and coloring completed (handwritten or digital). (If handwritten, this should be on plain white paper) and should use your desmos outlines as the blueprint. You can shade and color as much as your heart desires but it should look like your desmos graph in general. Remember, this is Escher inspired.

5. Reflection Narrative - This is the part where you put everything together, to sum up, and is free to your imagination! You could maybe record a screencast to complete the narrative by explaining verbally; you could put all components together using storytelling software and submit it; you could go the old-fashioned route and just type a paper... I'm not picky...I JUST NEED ANSWERS, PEOPLE!

I'm looking for the answers to these questions, this is a sample of answers to these questions:

a. Describe your function rule, in words.

Here are some words for you to reference as you write:

counter-clockwise, clockwise, shifted _ units _, stretched by a factor of _, compressed by a factor of _, reflected over the line _, slide, turn, flip, enlarge, reduce

b. What color is each transformation's range on the graphed outlines "blueprint"?

c. For your translation: Pick 2 points on your preimage. Show that 2 lines from those preimage points to their corresponding image points are || (parallel) using slope.

d. For your dilation: Pick 2 points on your preimage and find the slope and distance. Find the slope and distance of the corresponding side of your image. Show that the corresponding sides are || (parallel) and the ratio of the distances is equivalent to the stated scale factor. Then, find the distance between a point on the preimage to the center of dilation and the corresponding point on the image to the center of dilation. Show that the ratio of the distances is equivalent to the stated scale factor.

e. For your Reflection: Use slope to show that the lines from the preimage points to their corresponding image points are perpendicular to the reflection line and that the reflection line is the midpoint of preimage and image point.

f. For your rotation: Find the distance between a point on the preimage to the center of rotation and the corresponding point on the image to the center of rotation. Show that the angle of rotation is equal to your stated rule using slope.

g. How are x- and y-axis reflections similar? How are they different?

h. Compare and contrast clockwise and counterclockwise rotations.

i. What determines whether an image shrinks or enlarges in a dilation?

j. What is your final composite function for the final output?

k. Did you run into any hurdles while completing the project? How did you overcome them and what would you do differently next time to avoid them?

Escher Artwork Rubric

Area of Focus	4 - Mastered	3 - Near Mastered	2 - Proficient (Approaching)	1 - Developing (Needs Works)
Part 1: Determining a Plan				
Asymmetrical Image	The original image used does not contain any rotational and/or reflectional symmetry in any way.	The original image used may have rotational and/or reflectional symmetry when looking at the outline but the details within the image make it asymmetrical.	The original image used may have rotational and/or reflectional symmetry when looking at the outline and details BUT changes are still apparent after making transformations.	No original image provided -OR- The original image doesn't allow for changes to be viewed after transformations.
Original Design	The original image has a minimum of 10 coordinates along the outline which make the basic shape when graphed and is labeled with a letter and the coordinate (x,y) for every point with no errors.	The original image has coordinates along the outline which are labeled with a letter and the coordinate (x,y) with minor errors. When coordinates are graphed, the basic outline can be seen but has minor errors.	The original image has coordinates along the outline BUT may be missing letters or when graphed the coordinates will not produce the basic outline.	The original image has no coordinates along the outline or the coordinates are incorrect for all points.
Part 2: Mathematical Content (x2) I can translate, rotate, reflect, and dilate geometric figures on the coordinate plane.				
Number of transformations I can identify and write rules for transformations that will map an object back onto itself OR map one object onto another.	Created 4 new images (1 of each type of transformation) providing the preimage coordinate, transformation function, image coordinates, and full evidence of how each is determined shown over the entire project.	Created 4 new images providing the preimage coordinate, transformation function, image coordinates, with some evidence of how each is determined shown over the entire project.	Created 4 new images providing the preimage coordinate, transformation function, image coordinates, with evidence of how each is determined BUT not shown over the entire project.	Created less than 4 new images and/or failed to provide the necessary information with little to no evidence shown over the entire project.
Graphed Outlines I can identify and use transformations to create new images.	The 5 outlines (preimage and all 4 transformations) can be viewed in a different color and the coordinates of each new image are mathematically correct according to the provided transformation rule with no errors.	The 5 outlines can be viewed in a different color. The coordinates of each new image are mathematically correct according to the provided transformation rule with minor errors.	The 5 outlines can be viewed in a different color and the coordinates of each new image show a transformation BUT are not mathematically correct according to the provided transformation rule.	There are not 5 outlines on the graph. -OR- No transformations can be deciphered.
Mathematical Description I can determine coordinates for translated, rotated, reflected, or dilated figures without graphing.	All 4 transformations have the corresponding image coordinates for every preimage coordinate. They are mathematically correct according to the provided transformation rule with no errors.	All 4 transformations have the corresponding image coordinates for every preimage coordinate and they are mathematically correct according to the provided transformation rule with minor errors.	All 4 transformations have the corresponding image coordinates and the coordinates of each new image show a transformation BUT are not mathematically correct according to the provided transformation rule.	Some of the preimage/image coordinates are left out of the transformation list. -OR- Coordinates do not show a transformation.
Correct Notation I can write transformations in coordinate notation.	Each of the 4 transformations is written using the correct function notation including composition rules when translating from any image other than the original. Every new image coordinate is output from one of the provided functions.	Each of the 4 transformations is written using the correct function notation without any necessary composition rules. Every new image coordinate is output from one of the provided functions.	Each of the 4 transformations is written using the correct function notation BUT the new image coordinates provided do not output from one of the provided functions.	Each of the 4 transformations is not written correctly in function notation.
Part 3: Final Compilation				
Final Canvas	The preimage and every image are drawn and colored completely with every detail shown. Colored/shaded to match the order and design of the graphed outlines with no errors.	The preimage and every image are drawn and colored completely with every detail shown. Colored/shaded to match the order and design of the graphed outlines with minor errors.	The preimage and every image are drawn and colored completely with every detail shown. Colored/shaded BUT there is no math to support the design of the picture.	The final canvas does not show each of the images and preimages details. -OR- There is no color/shading.
Reflection Questions	All parts of the questions are addressed thoroughly and provide clarity and details which are not evident when looking at mathematical content. There are no questions about how the project components connect.	All parts of the questions are addressed thoroughly and provide clarity and details which are not evident when looking at mathematical content. There may be 1 or 2 questions about how the project components connect.	All parts of the questions are addressed but are vague and do not provide clarity to the project. There are still many questions about how the components connect.	Some parts of the questions are not addressed.
Content Questions	Provides a deep understanding of the questions asked and makes strong connections to examples involving math.	Provides an understanding of the questions asked and makes strong connections to examples involving math.	Provides some understanding of the questions asked without connections to examples involving math.	Provides a minimal understanding of the questions asked -OR- doesn't make connections to examples involving math.

Material List

Chromebook/Internet
Color Pencils
Desmos.com
Graph Paper
Journal
Patty paper
Pencil
Protractor
Ruler

Student Resources

Kids N Clicks
https://kidsnclicks.com/

For kids 6 – 16 years old. Intended to help students build positive habits through resources for developing growth mindset, building confidence and securing digital well-being.

Mindfulness for Teens
http://mindfulnessforteens.com/

This website provides information, tools, and resources to help teens get started handling stress and taking positive risks which hopefully results in living life more fully.

Why students should have mental health days
https://www.ted.com/talks/hailey_hardcastle_why_students_should_have_mental_health_days?utm_campaign=tedspread&utm_medium=referral&utm_source=tedcomshare

Physical and mental health are equally important in nature and should be treated that way at school. Hailey Hardcastle established a network of student activist to make schools better for youth struggling with mental health.

Teacher Resources

Reading List

Brock, Annie, and Heather Hundley. *The Growth Mindset Playbook a Teacher's Guide to Promoting Student Success*. Berkeley, CA: Ulysses Press, 2017.

There seems to be a dynamic shift in CMS in which Professional Development is focusing on teaching students to be grittier. Programs like Personalized Digital Learning, AVID, and Universal Design gives teachers instructional strategies and a framework to empower students to take ownership in their learning. Implementing these programs as they stand is more effective if the educator knows how to be the coach, not just the teacher. *The Growth Mindset Playbook a*

Teacher's Guide to Promoting Student Success taught me how to have the conversations to effectively coach students to a growth mindset. The book takes the teacher and student over a yearlong journey to developing a growth mindset for both the teacher and student. The text includes lesson plans on how to implement each lesson. Many of the lessons in this book are echoed by Jo Boaler in *Mathematical Mindsets: Unleashing Students' Potential through Creative Math, Inspiring Messages, and Innovative Teaching* and Carol Dweck in *Mindset: The New Psychology of Success*

Videos

Carol S. Dweck: TED Talk
https://www.ted.com/talks/carol_dweck_the_power_of_believing_that_you_can_improve?utm_campaign=tedspread&utm_medium=referral&utm_source=tedcomshare

In this video Dr. Dweck explains the science behind a growth mindset. This video should be shared with students at the beginning of the school year. Teaching students about how their brain works when presented with new information will help them self-regulate in difficult learning moments.

Childhood101
https://childhood101.com/growth-mindset-videos/

Growth Mindset Videos: 10 TEDTalks to Share With Your Students and Children

Philosophical Chairs-AVID strategy

An example of the implementation of an AVID strategy called Philosophical Chairs. Philosophical chairs is a process in the teacher present students with contradictory prompts/questions and students address these positions through deep, academic discourse in a structured, formal process. The Philosophical Chairs process provides students with opportunities to improve their verbal capabilities and fluency, develop their use of precise academic and content language, as well as form participate in team-building.

Video of modeling Philosophical Chairs https://youtu.be/DpNri8w75p8

One Pager – AVID strategy
https://www.alvordschools.org/site/handlers/filedownload.ashx?moduleinstanceid=18523&dataid=30429&FileName=One_Pager_Overview.pdf

A One-Pager is a creative response to the learning experience. It allows students to respond imaginatively while being brief and concise in making connections between words and images. Students explain their personal thinking about what they experienced, create their own ideas on how the information is connected and should be understood by the audience that views the One-Pager.

Video of modeling introduction to One Pagers https://youtu.be/X-0BmQhG9u4

Websites

Curriculum Ideas: Provides a curriculum for developing a mindful practice in the classroom. Includes a reflection after each practice.

- https://www.education.com/lesson-plans/mindfulness/
- https://move-with-me.com/wp-content/uploads/2013/08/MwM-Curriculum-website-pdfs.pdf
- https://www.mentalhealthexcellence.org/wp-content/uploads/2013/10/Mindful-Schools-K5-Curriculum-first-2-lessons.pdf

EdPuzzle.com

A tool to track students' comprehension. Teachers can check if students are watching videos, how many times they're watching each section, and if they're understanding the content. Teachers can add their own voice narration and questions. Helps to facilitate self-paced learning with interactive video lessons.

Desmos.com

Interactive and creative activities for math classes. Teachers can create a class and have students join the class. Students will be able to talk with each during Polygraph activities, complete discovery tasks analyzing patterns and relationships, and review concepts during the card sort activities.

Mindful Schools.org
https://www.mindfulschools.org/resources/explore-mindful-resources/

Includes resources to assist schools with introducing mindfulness schoolwide: films, lesson videos, presentations, guided audios, and books

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Endnotes

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[3] Sally Ventura. "The High Schooler's Guide to Happiness."
[4] Jordana Etkin, "Understanding Self-Regulation in Education."
[5] Lisa-Marie Emerson, Natalja Nabinger De Diaz, Ashra Sherwood, and Allison Waters. "Mindfulness Interventions in Schools: Integrity and Feasibility of Implementation."
[6] Ibid.
[7] Image recreated from google images of Maslow's Hierarchy
[8] Molly Fisher and Ben Crawford. "From School of Crisis to Distinguished."

[9] Hoanglan Cardinal. “Benefits of Mindfulness Training in Schools.”
[10] Ibid.
[11] Annie Brock and Heather Hundley. *The Growth Mindset Playbook a Teacher's Guide to Promoting Student Success*. Pg 7
[12] Ibid. pg 9-11
[13] Ibid. pg 24-25
[14] Ibid. pg 26
[15] Stephen Rushton and Anne Juola-Rushton. “Classroom Learning Environment, Brain Research and the ‘No Child Left Behind’ Initiative: 6 Years Later.”
[16] North Carolina Department of Public Instruction. “NC Educator Effectiveness System (NCEES)”
[17] Jaleel R. Howard, Tanya Milner-McCall, and Tyrone C. Howard. *No More Teaching without Positive Relationships*. Pg 9
[18] Sally Ventura. “The High Schooler's Guide to Happiness.”
[19] April LaGue, Gene Eakin, and Cass Dykeman. “The Impact of Mindfulness-Based Cognitive Therapy on Math Anxiety in Adolescents.”
[20] Jo Boaler. *Mathematical Mindsets: Unleashing Students' Potential through Creative Math, Inspiring Messages, and Innovative Teaching*. Pg 38
[21] Ibid. pg 144
[22] Rita Hudgens, Beki Fraser, Andy White, Judy Burges Krings, Brad Desmond, and Susan Kopynec. “Helping You Help Others.”
[23] Maggie Seaver. “What Mindfulness Does to Your Brain: The Science of Neuroplasticity.”
[24] “Tapping 101 - Learn the Basics of the Tapping Technique.”
[25] “Jo Teaching a Visual Dot Card Number Talk.”
[26] EFT Master. “101 Affirmations for Tapping Practice.”
[27] “Jo Teaching a Visual Dot Card Number Talk.”
[28] Rita Hudgens, Beki Fraser, Andy White, Judy Burges Krings, Brad Desmond, and Susan Kopynec. “Helping You Help Others.”
[29] Maggie Seaver. “What Mindfulness Does to Your Brain: The Science of Neuroplasticity.”

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