The Metro Model Guidebook

Prepared for the NewSchools Venture Fund



Battelle's vision is to be a major force in science and technology discovery and in the translation of knowledge into innovative applications that have significant societal and economic impacts. Science, technology, engineering, and math (STEM) is the foundation of Battelle's existence. Our scientists and researchers rely on their STEM expertise every day to drive innovation. This drives our conviction that all young people deserve a strong education in STEM. Together with public and private partners, we're bringing quality STEM education to millions of students across the U.S.

This guidebook was made possible through the generous support of the NewSchools Venture Fund. Founded in 1998, the NewSchools Venture Fund was founded on the belief that entrepreneurs can create new solutions with the potential to reimagine public education for millions of students. Their mission is to reimagine public education through powerful ideas and passionate entrepreneurs so that all children – especially those in underserved communities – have the opportunity to succeed.

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In 2006, Metro Early College High School became the first STEM school in the state of Ohio.

First conceived as a joint endeavor between Battelle Memorial Institute and The Ohio State University, we aimed to address educational barriers for all students, especially economically disadvantaged students who were often disengaged by traditional avenues to educational success.

Like all experiments, our model needed refinement over time to achieve the goals we first set out to accomplish. This guidebook represents an important step in that process, made possible in part through a grant from the NewSchools Venture Fund. Thanks to their support, we spent a year studying the school to crystallize the model into its core components. After more than a decade of iteration and growth, what began as a small social science experiment in the field



of education has emerged as an innovative school model that will inspire future generations of students to unlock their true potential.

It is with great pleasure, and more than a little pride, that we present the Metro Model Guidebook. It is our hope that Metro continues to evolve, expanding beyond what is covered in this document. Education is not a stagnant vocation, and the needs of our students are constantly changing – so our model will continue to evolve to meet those needs. But, for now, the pages that follow capture the model as it stands in 2019.

It is our desire to expand the model in our region, state, and nation, and our hope that we will gather partners to join us in this endeavor. We understand that we do not have all the answers and that one particular model will not serve all kids, but, in terms of innovative school design, we believe the Metro Model Guidebook is a good place to start.

Mury Hall

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Navigating this Guidebook

Since its opening in 2006, the educators and administrators at the Metro Schools have remained dedicated to providing students with a personalized learning experience that prepares them for success in life after high school.

While the school has evolved over the years to address the needs of students, five Guiding Principles have remained non-negotiable: 1) Personalization; 2) Science, Technology, Engineering, and Math (STEM) Literacy; 3) College and Career Readiness; 4) Student Autonomy; and 5) Cultural Competency.

This document is organized in sections by the Guiding Principles. Within each Guiding Principle are the corresponding Core Practices. These practices do not act in isolation. In fact, these practices often overlap, and students frequently engage in one or multiple practices at a time. There is no single practice that is more important than another, nor do they occur in a linear fashion.

Not all schools operate in the same environment or with the same resources. When reading through these principles and practices, view them as guardrails or guidelines. Some schools may favor implementing these practices as is, while others may desire to adjust practices to meet their own unique needs. Regardless of adaptation, the goal should remain constant: a personalized learning experience to prepare students for success after high school.

By the end of this document, readers should be able to identify the Guiding Principles and Core Practices of the Metro Model, understand the rationale behind their existence, and begin to explore implementation in their local context.

This guidebook represents the Metro Model's approach to transforming education—it is meant to be used and kept readily available. Readers should feel encouraged to read excerpts at meetings, mark up the margins with ideas, copy pages, and refer to it often to generate ideas.

STEM Education and the Metro Schools

Before diving into the Metro Model, it is important to build a foundational understanding of STEM education and how it guides activities at the Metro Schools. The following section provides a brief overview of STEM education, the Metro Schools, and the two combined – the student's journey through the Metro Schools.

Tenets of STEM Education

STEM education is most widely known as an educational process involving Science, Technology, Engineering, and Math that compels students to work together across disciplines in solving real-world problems.

While Metro certainly has roots in this traditional view of STEM, Metro also supplements its model with an alternative acronym: "*Strategies That Engage Minds*." Content knowledge is important but using that knowledge to solve real-world problems is the main objective. Siloed content knowledge is not useful without a focus on the skills necessary to promote advocacy, efficacy, and research within STEM fields.

Lastly, Metro believes that there is no select group of "STEM students." STEM is for every student and each student has the capacity to solve problems and be an asset to the team. To provide effective STEM education for every student, pedagogy must go beyond the acronym in four ways.

1) Centered on Students

Students must learn through seeking, testing, and applying new knowledge. Students must work with their peers, ask questions, and challenge one another. The classroom teacher should serve as a facilitator, not a gatekeeper of knowledge. The teacher must prepare lessons that promote inquiry, critical thinking, and collaboration so the class can discover knowledge together.

2) Focused on Skills and Habits

STEM education must build problem-solvers, not fact reciters. To be successful in any field, students need more than a high school diploma and college credits – they must be able to work in teams, communicate clearly, and reach out for help when necessary.

3) Based in the Real World

STEM curriculum must be relevant to the expectations of the real world. STEM schools move beyond the typical teaching and learning protocols that require rote recall of knowledge with little to no application. Teachers should ensure that students are thinking and using knowledge in complex ways, not just learning siloed concepts.

4) Outside of the Classroom

STEM education must leverage local partnerships to benefit students and the community simultaneously. Local business partners and community organizations are integral members of the school community and provide an invaluable outlet for students to learn outside of the classroom. STEM schools must collaborate with these organizations to ensure that students can cement STEM skills and habits into real-world contexts.

About the Metro Schools

"Our vision is to provide a small and intellectually vibrant learning community designed to serve students who want a personalized learning experience that prepares them for a connected world where Math, Science, and Technology are vitally important. All Metro students engage in a personally relevant and academically rigorous curriculum within a safe and trusting environment." (Metro Schools, 2019) In 2006, Metro Early College High School (NKA "Metro Schools") was born out of the desire of both The Ohio State University and Battelle Memorial Institute to create a "small" STEM school with a big footprint. Both organizations believed that the world needed a diverse workforce leveraging every mind possible to solve the world's biggest problems. However, young women and students of color were earning STEM degrees at much lower rates than young white men. They also saw a troubling trend in education—high school graduates were increasingly unprepared for college or careers.

They aimed to make a quality STEM education available to everyone, regardless of zip code or finances, and to provide additional support to students who may not see themselves in a STEM career. Now, 13 years later, the first STEM school in the State of Ohio is also one of the best.

To create its diverse learning community, Metro builds its student body from a purely lottery-based admission process that proportionally admits students from school districts across Central Ohio. Fifty percent (50%) of these students originate from Columbus City Schools, the largest district in the region. Uniting a wide diversity of students across an entire metropolitan region creates a learning community that prepares students to confidently navigate a variety of contexts, cultures, and environments.

To ensure that the entire student body is prepared to thrive in the real world, Metro takes a holistic approach to educating students. Educators and administrators focus on cognitive, social, emotional, and physical development through experiential learning, service-learning, and family and community support. Students graduate Metro connected to their communities, capable of solving complex problems, and practitioners of responsible, effective citizenry.

Data from the Ohio Department of Education supports this claim, specifically the "Prepared for Success" component in the 2017-18 school year. This measure assesses schools based on how many students earn remediation- free SAT/ACT scores, AP/IB classes, industry credentials, and early college credits. The score of every public, nonselective high school is represented in Figure 1, compared to the socioeconomics of their students.

The graph shows a strong correlation between performance and student socioeconomics. In general, schools with fewer economically disadvantaged students perform better than those with many. This trend mirrors others where income and educational performance are linked – but Metro is a trend-breaker.



Metro's Prepared for Success score puts it in the top 6% of all public high

Figure 1. Metro and Nonselective Public High Schools in Ohio

schools in Ohio, but 34% of its students are economically disadvantaged. Metro provides an elite education to students regardless of their family's income. The Metro Model firmly believes that STEM is for every student, regardless of their zip code.

This guidebook is an attempt to codify the essential components of this educational model to further understand how it functions today, and how it could provide more opportunity for students in the future.

The Metro Model: Guiding Principles and Core Practices

GUIDING PRINCIPLES	CORE PRACTICES
Personalization	Mastery Flexible Scheduling Advisory
STEM Literacy	Design Challenges
College and Career Readiness	The Metro Habits Internships Early College Experiences
Student Autonomy	Portfolio Roundtable Gateway
Cultural Competency	Nonselective Lottery Admission Culturally Informed Practices Social and Emotional Supports

Guiding Principle 1: Personalization

Guiding Principle: Personalization

Core Practices

- Mastery
- Flexible Scheduling
- Advisory

Overview

Every student has different needs and requires different supports to thrive. Effective education is not "one-size-fitsall," so the Metro Model



emphasizes Personalization to support the diverse needs of learners.

Advocates for traditional education may argue that discrete classrooms, subject area siloes, and predictable schedules allow a school to operate smoothly. As long as a student receives a grade above 60%, they move on to the next grade – even if they lack content knowledge necessary for future classes. This approach prioritizes logistical simplicity over student learning.

Metro takes a different approach. Students have a wide variety of strengths and growth areas, so Personalization focuses on addressing and developing those strengths directly and not ignoring them. If a subject is challenging for a student, the student receives more time to master the content. If a student is excelling in a subject, they may finish and move on more quickly. Flexible Scheduling allows the school administration to offer student more time to fully take advantage of Mastery, and Advisory provides an opportunity to develop personal relationships with teacher leaders at the school.

Personalization represents a balancing act for teachers and school leaders. How can they adhere to a common system while tailoring it to individual students? For successful Personalization in the Metro Model, teachers and administrators much fully commit to the following Core Practices: Mastery, Flexible Scheduling, and Advisory.

Core Practice: Mastery

Components of Mastery:

- Remediation
- Flexibility with Traditional Assessment

Overview

Put simply, Mastery means that a student can only pass a class by earning 90% or above on every Mastery assignment. On the more conceptual side, Mastery refers to true learning by using skills or content knowledge in a new context and not just parroting facts.

Students must display Mastery in a course in order to receive credit. If a student receives below 90% on a Mastery assignment, they are allowed more time to remediate.

Figure 2 compares a traditional approach to grading versus Mastery. In traditional education, the nonnegotiable aspect is time. Whatever grade the student receives on the final day of the semester is what is placed on their record. If they receive a 70% in the class, they advance without presumably

understanding 30% of the content. Mastery challenges this traditional approach. The non-negotiable for Metro is content knowledge instead of time. If a student is performing below the 90% benchmark, they are given additional time to master the content before moving on.

Mastery is critical to Metro's focus on early college access for a diverse student body. Mastery ensures that students receive the extra help needed on challenging subjects, while receiving acceleration in subjects for which they thrive.

Remediation

When a student does not demonstrate Mastery on an assignment, they are expected to remediate and are given another opportunity to demonstrate Mastery of the content and skills. Remediation is the process students take to relearn content and skills they have attempted, but not yet mastered.

To evaluate the need and rigor of remediation for a student, teachers should assess the student's work through the framework of either a foundational or Mastery assessment. In the Metro Model, this assessment is synonymous with formative and summative assessments – foundational assessments measure the initial understanding students have of content, while Mastery evaluates their ability to synthesize and apply their new knowledge.

Foundational assignments are required but do not factor into a student's grade. Students complete foundational assessments to initially learn the material, highlight unknown areas at the outset, and sometimes remediate their learning. In most classes, students must





Figure 2. Comparison of a Traditional Approach to Grading Versus Mastery

submit all foundational assignments as a requirement for mastering the class. Points are not removed for late work, but all assignments must be completed and submitted.

Mastery assignments do factor into a student's grade. Students complete Mastery assessments to prove remediation is not needed. If a student does not achieve Mastery, they must remediate the assignment until they score higher than 90%.

Remediation may include redoing foundational assessments before attempting the Mastery assessment again, which means teachers embed multiple opportunities into a class for students to demonstrate Mastery. This process is a feedback loop, formalized to provide students more chances to master the material before moving them ahead.

Opportunities for remediation in class and during school-day office hours allow all students a chance to remediate. Some students have family, employment, and transportation obligations that would limit and interfere with before- or after-school remediation time. A school should realize this issue when developing remediation and should visualize the practice as part of schooling, not an add-on.

All this being said, some students may still benefit from retaking a class in its entirety. When retaking a class, the new grade replaces the older one upon completion of the class. While most Metro students are able to complete their high school requirements in about two years, other students have the flexibility to retake classes without penalty.

Flexibility with the Traditional Assessment

Since Metro takes a non-traditional approach to evaluation, it is important to consider the implications should a student need to transfer out of Metro.

If a student transfers to another high school, their grades (WIP or Mastery) are translated into letter grades that correspond to the traditional grading system. Most of the time, these grades will be As, as most students complete a class to Mastery above 90%. For unmastered classes, students receive their unremediated grade. In the summer before a student's Junior year, their WIP scores are transitioned to letter grades.

Students can always obtain that percentage, but this formal transition helps students understand their progress toward graduation. Since many higher education institutions are not compatible with the Mastery grading scale, college-bound students' grades are transitioned to letter grades that align with university standards in their application process. As noted later in the Student Autonomy section of this document, Metro students will also have a handful of deliverables they can use to supplement their college application process, a school profile is sent with transcripts to provide clarification and information on Mastery.

Core Practice: Flexible Scheduling

Components of Flexible Scheduling:

- Onboarding
- J-Term (Recovery, Intercession, and Extension)

Overview

With an inflexible calendar, Mastery can only have a limited effect. Flexible Scheduling makes Personalization possible by structurally supporting the system of Mastery with a cooperative school calendar.

At Metro, some students may be above grade level in Math, below grade level in Reading, or any combination in between. By scheduling students based on their specific aptitudes, students' education can be more personalized. In regard to scheduling, the Metro Model is unique in two ways: onboarding and J-Term.

Onboarding

Before school begins in the Fall, incoming sixth grade and ninth grade students are required to take placement tests in English and Math. Metro uses the Northwestern Evaluation Association's Measures of Academic Progress (NWEA MAPS) test for English/Language Arts and Math. These scores allow administrators to enroll students in classes suited to their incoming content knowledge.

In upper grades, teacher feedback and recommendations guide administration as they build each student's schedule. After seventh and eighth graders are scheduled into classes, sixth graders are scheduled according to their scores, previous grades, and any additional feedback in their student file. Based on the needs of students, administrators decide how many sections of each class to offer. Within the first three days of classes, pre-tests are administered to confirm that students have been placed in a suitable class. Any adjustments are then made as needed.

Throughout the scheduling process, staff must remain mindful of student and parent responses. Although the Metro Model believes in the benefits of Personalization, families may feel like a student placed in a class below grade level is not in their best interest. Open communication can help alleviate this concern, and documenting and demonstrating consistency with acceleration and remediation policies is a valuable way to justify decisions.

J-Term

Despite extra opportunities, office hours, remediation, and re-teaching throughout the term, some students may still need more support to complete work to a Mastery level. January term, or J-Term, is a five-week term after Winter Break that provides additional time for students to achieve Mastery in Fall classes.

After final exams before the Winter Break, teachers record final scores and recommend each student to one of three categories: Mastery, Close to Mastery, and Recovery. Which category a student falls into depends mostly on the final score they achieved in the class, but could be influenced by teacher recommendation.

J-Term provides three kinds of classes to students based on the above categories: Recovery, Intercession, and Extension.

Recovery

Students needing additional support to reach Mastery in courses are scheduled into a Recovery class. Generally, these students score 80% or lower. Knowing these students from the Fall semester, teachers plan the course to cover the core standards that were not mastered by students. These classes are intentionally smaller and include more personalized help. Students will stay in these classes the entire J-Term to ensure they achieve Mastery by the beginning of the Spring semester.

Intercession

Students who are close to Mastery, generally between 80-90%, are assigned to Intersession, which is essentially an independent study with as-needed support. These classes are offered three times a week, giving students time to remediate work with their Fall teachers that was not at a Mastery level. During this time, students work at their own pace to complete missing or unmastered assignments.

During this time, teachers conference with students, answer individual questions, re-teach to small groups, and offer more personalized feedback. Some students need an Intersession for more than one class. In that case, their schedule is changed when they master the necessary material, then are moved to their next classroom. Teachers also submit grade change forms for students who work to Mastery, allowing for Fall records to be modified to reflect progress.

Extension

Most students who master a class have an opportunity to take an Extension Class in J-Term. Teachers and administration collaborate to create project-based classes centered on students' interests.

These classes leverage the unique strengths of teachers that may not be fully realized in their semester classes. In addition to providing an opportunity for teachers to bring their outside interests into the classroom, Extension provides an opportunity for outside professionals and community partners to bring the real world to students during the school day. Partnering with outside professionals and community members for Extension also builds relationships for possible mentors that students will work with during Early College Experiences (ECE) (discussed later in this document).

Examples of Extension Classes include:

- Toon Town: A class on the history of animation that teaches students how to create a stop motion claymation.
- Circuit Playground: A basic coding and circuitry class where students create games led by the school's technology coordinator.
- Green Architecture: A Project Lead the Way class focused on environmentally friendly design where students build birdhouses.
- Experiential Government: A class focused on connecting to and with Ohio's governmental systems and officials.

Core Practice: Advisory

Components of Advisory:

- Structure
- Office Hours

Overview

Advisory serves as a home base for students throughout their entire time at Metro. During Advisory, students focus on the Metro Habits, build community with their peers, and foster a relationship with their Advisor. These activities are important because it drives student-to-student and student-to-teacher relationships, contributing to the culture of a "home away from home." When the Metro Model can seem a bit complicated, Advisory serves as a safe place for students to ask for help from peers and Advisors.

As a central opportunity for students to develop relationships with educators, Advisory is an important aspect of Personalization in the Metro Model. Advisors have a unique perspective on students in their cohort, which is useful when making decisions on student schedules. They also have a deep knowledge of a student's habits on an individual level.

Structure

For three days a week, students and Advisors spend an hour together in Advisory. Advisories in the Metro Model are comprised of about 25 to 30 students across grade levels led by two teachers acting as Advisors. New teachers are paired with more experienced ones for a chance to collaborate by running Advisory together.

To establish Advisories, Metro Middle School students spend the first two days of the school year rotating between presentations. During the first day, Metro holds a student orientation. Students attend different stations where they learn about various aspects of Metro like technology, scheduling, classes, Mastery, and more. Advisors also teach a Metro Habit or skill students will need to be successful. Typically, up to two teachers lead a session so students can meet their potential Advisors and become acquainted with the teachers at Metro. Then students fill out a Google Form to choose their top three Advisors. Teachers and administration accommodate those preferences when building Advisory groups.

High School students are involved in a similar process to choose Advisory and spend the first three to five days of school together, which allows time for students and teachers to become acquainted with one another and to start building positive relationships. During these first days of school, the Advisory class participates in Metro culture lessons, team building activities, lunches and breakfasts together, and a scavenger hunt on The Ohio State University's campus.

It is essential that Advisory be fully incorporated into school operations and culture. To ensure this process occurs, Metro dedicates 60 minutes of each day to Advisory (the exact amount and schedule is dependent on grade level). The Dean of Students develops a clear curriculum for Advisories centering on the Metro Habits. Teachers still retain a sense of autonomy, but students participate in a schoolwide endeavor.

Advisory adapts to help students at different stages in their Metro Journey. These stages are generally split by grade, except for ECE, which will be explained in depth later in this document. The following paragraphs provide the objectives of Advisory by grade level. Note, many of the concepts listed below will also be discussed in subsequent sections.

Grades 6-8

Students build relationships, explore careers, and receive their first taste of the Metro Habits. Additional time is spent onboarding students to Mastery assessment, encouraging them to take control of their own educational path. Students should begin to work on their Portfolios and participate in their Roundtables. At the close of students' eighth grade year, Advisory should transition students to the high school experience.

Grades 9-11

Students continue to build relationships, explore careers, and expand on the Metro Habits. Advisory in the later grades prepares students for ECE. During grades 9-10, students follow a pathway that allows them to prepare for college courses and ECEs. Students continue to work on their Portfolio, participate in Roundtables, and eventually go through their Gateway to ECEs.

Grade 11/12 (Post-Gateway)

Additional information on Advisory for ECE students is available in the ECE section. ECE students have their Advisory experience with their cohort. Advisors focus on two goals: 1) finding a college and degree program that is right for them; and 2) providing professional development including resumes, soft skills, and mock interviews. The goal of an ECE Advisory experience is to prioritize Student Autonomy to prepare them for a successful college experience. Note, students in their Junior year or below join this ECE Advisory, while Seniors in ECEs join Senior Communications below.

Grade 12

Senior Communications is the last Advisory component prior to graduation. In Senior Communications, students work through the college application and scholarship process, and complete service hours. For many Metro students, this class is the only class that they attend on the high school campus during their fourth and final year. Note, Senior Communications is not in addition to another Advisory. For all Seniors, this is their Advisory.

Office Hours

Teachers provide the extra time needed for students to achieve Mastery by offering office hours twice a week. This time is in addition to Advisory; however, office hours are open during the morning Advisory period. Teachers select the day of their office hours and invite students to ask questions during their Advisory period. Students spend this time retaking tests, asking individual questions, and completing homework with teacher support.

It is important to be inclusive of students who may lack reliable transportation, or have other commitments, that cannot arrive early or stay late for office hours. Thus, building time into the school day affords all students the same opportunity for assistance.

Summary

Personalization is the Guiding Principle that provides the framework for educators and administrators to meet the unique needs of each student. Personalization is supported by three main Core Practices: Mastery, Flexible Scheduling, and Advisory.

Mastery is a form of assessment that requires students to earn a 90% or above (which indicates their ability to synthesize and apply new content knowledge) in a class in order to proceed to the next class. Mastery is an important component of Personalization because it requires educators to be flexible with students based on their aptitudes and needs. Similarly, the practice of **Flexible Scheduling** – scheduling students based on their competencies and not just grade level – enables students to excel where they have strengths and receive additional help in the more challenging courses. Flexible Scheduling is a key component in launching students toward early college credit. Last, there is **Advisory**, which is the Core Practice that provides a home base for students. Advisory serves as a time and community where students build their peer networks, sharpen their Metro Habits, and further develop relationships with their Advisor.

For successful implementation, Personalization requires teachers to be equitable (or demonstrate as little bias as possible) in their application of the rules, use a data-driven set of criteria within which to apply the rules, and apply the rules even when parents/guardians contest the application.

Guiding Principle 2: STEM Literacy

Guiding Principle: STEM Literacy

Core Practice

Design Challenges

Overview

In the Metro Model, STEM learning goes beyond Science, Technology, Engineering, and Math. STEM is also about *Strategies That Engage Minds*. STEM Literacy is understanding the



intersection of traditional STEM subjects and working to develop 21st-century skills like creativity, communication, and collaboration to positively impact the world. Content knowledge is important, but it needs to be applied to make an impact on the world. Learning in a vacuum may lead to a good grade, but the best STEM learning occurs when classroom concepts are applied to real-world problems.

Metro students demonstrate STEM Literacy when they apply the Design Cycle during Design Challenges to collaborate across disciplines to solve real-world problems.

While STEM Literacy permeates all aspects of the Metro Model, the best illustration of STEM Literacy originates through the Design Challenge.

Core Practice: Design Challenges

Components of Design Challenges:

- Timeline and Process
- Teacher's Role
- Design Cycle
- Rubric

Overview

Students often ask, "Why do we have to do this?" Sometimes the answer is simply that they are included in the academic standards. Teaching to standards like a checklist may adhere to the "letter of the law," but not to the spirit of education. Design Challenges keep the answer to "why" at the front of learning.

At Metro, a Design Challenge is a multi-phase, cross-curricular project that challenges students to work in teams to solve a real-world problem. Design Challenges aim to meet academic standards while couching them in rigorous, engaging problem-solving that relates to students' real worlds. Design Challenges offer a unique opportunity to couple soft skills with the Design Cycle. While students need the skills to solve problems in an academic setting, they also need the ability to effectively work with peers of diverse backgrounds in non-academic settings. The Metro Model aims to mirror these experiences in its learning community.

Timeline and Process

At Metro, Design Challenges occur as a schoolwide event over nine weeks during Spring semester. The following sections provide a general timeline for Design Challenge implementation.

First, teachers organize students from the same Advisory into teams of five. While Design Challenges are schoolwide, student grades for Design Challenges are assigned to the Advisory course.

Second, students and teachers collaborate to identify a central problem for the challenge – the more a group can relate to the problem, the more valuable the experience. For several weeks, all classes use the central problem as the subject of study, applying different lenses to the problem. For example, for a Design Challenge on clean water, a Science class might study the chemistry of water, while an English class studies a literary piece on access to clean water.

Third, teachers provide students with a specific set of materials and constraints. Teachers should not prescribe specific solutions or approaches; rather, problems should remain open-ended. Potential solutions emerge from student research without teacher intervention.

Last, students work as a team to prototype a solution, iterate on their design, and then present it to adults and peers. By the end of their Senior year, students can use design thinking to prepare for college coursework or a career of their choice.

Table 1 provides a general overview of the Design Challenge timeline. When developing and implementing Design Challenges, treat this timeline as a guardrail. Each school will need to adjust to meet the different needs of students. Keep in mind one of the objectives of the Metro Model is to provide a personalized learning experience that meets the unique needs of each student.



What is a "real-world problem"?

Battelle is the world's largest non-profit research and development institute. Since 1929, we have been applying science and technology to solve the world's biggest problems.

This is the same mission that drives our work in STEM education – how do we prepare today's students to solve tomorrow's problems?

At major technology centers and national laboratories around the world, Battelle conducts research and development, designs and manufactures products, and delivers critical services for government and commercial customers.

Examples of real-world problems Battelle is solving include: developing ways to help people overcome devastating neurological damage and disorders; creating tools for rapid screening of DNA sequences submitted for gene synthesis; and leading the way in development of new solutions for emerging environmental problems.

Table 1. Sample Design Challenge Timeline

Timeline	Activities
Week 1: Planning Teachers create prompt and materials for the challenge problem	Teachers collaborate with each other, the community, or independently to identify a problem that affects students. Choosing a problem that students can relate to is crucial in engaging students. When choosing the challenge's problem, the idea should be selected with enough lead time that allows for the coordination of all participants (students, staff, guest speakers), advertising, sample materials, curriculum alignment, and/or creating a school-specific timeline.
Week 2: "Hook Day" Teachers initiate the challenge with a "hook"/engaging activity and discuss objectives	Teachers dedicate an entire day or class period to introduce the Design Challenge. Examples of "hook day" activities include videos, guest speakers, games, field experiences, and discussions of current events. Close the activities by discussing the Design Challenge and students' objectives.
Week 3: Student Work Students brainstorm potential solutions and roadblocks surrounding the problem	Students and teachers work as a large group, small group, or as individuals to research potential solutions to the problem. Research can be done in the field or a laboratory, on a laptop, or in a library. Teachers should work with students to determine what is feasible and realistic.
Week 4: Prototype I Students draft potential solutions and research support for solutions	Students draft prototypes with their team. After researching potential solutions, students should discuss options with their group and identify how they can create or innovate solutions. Once students have agreed upon an idea, groups should informally present their solutions to peers or faculty for feedback. Students should incorporate feedback and begin making revisions. Prototypes are ideally physical products but can also be intellectual concepts.
Week 5: Revisions Students revisit draft/prototype to make revisions	Students revise their ideas and test any physical prototypes that have been built. Teachers can provide time in class or check in with groups separately. Students may need more or less time depending on the scope and scale of the project.
Week 6: Prototype II Students workshop draft/prototype with new alterations or "bugs" fixed	Students present their solutions to a group of peers or faculty that addresses prior feedback. Teachers should focus on growth or development from the previous workshop and the results from testing the prototype.
Week 7: Preparing Results Students test successful prototypes or continue to troubleshoot "bugs"	Students integrate final suggestions or continue to test their prototypes to gather additional data. Students should prepare their final report of findings on the successes or challenges of their potential solution.
Week 8: Showcase Final presentation/publication of results or ideas for future research	The school should hold a final showcase that involves everyone participating in the challenge, which can be "science fair style" in a large room, an event open to the community, or a competition. Regardless, this showcase should enable students to explain their methodology and how their solution addresses the original problem.

Teacher's Role

Teachers can tailor Design Challenges to any course, content, school setting, or timeframe. It can be as simple as a classroom activity involving teachers and students or a large-scale event involving administrators, staff, students, and families. The scale and content of the challenge real-world on the goals of the project and any potential time constraints.

Throughout the challenge, teachers should have the autonomy to support their students as they deem necessary. Teachers should integrate Personalization by adjusting timing, content, assessment strategies, and/or grouping depending on grade level, ability level, class size, time constraints, and/or challenge objectives.

Teachers should also focus on developing students' abilities to work effectively in teams, follow the design process, and provide and receive feedback. Using the Design Challenge as a cumulative project for the semester (or year) encourages students to reflect on their growth as individuals beyond grades or standards.

A teacher's role in leading Design Challenges is different than that of a lecturer in a traditional classroom. Ideally, the teacher serves as both a lead learner and a project manager.

As a lead learner, teachers are not expected to be masters of content or innovation; instead, they foster students' curiosity, allowing them to conduct research on the problem and formulate potential solutions. They do not hold all the correct answers and are not the gatekeeper of knowledge. Teachers should help guide each team's approach to the problem and act as a sounding board along the way. Design Challenges are intentionally open-ended, so the teacher cannot lead students to the "correct" answer because there is no "correct" answer. Students must have the freedom to explore ideas, build prototypes, and learn from personal failures on the way to a workable solution. Reflection is an important element throughout the process, spurred on by presentations to peers and adults.

As a project manager, teachers should be familiar with the Design Challenge process and help students pay attention to detail as they move through the Design Cycle. Teachers should aim to keep students on track with the timeline and on task, which can be difficult as students respond to failure, seek unworkable solutions, and respond to feedback.

Design Cycle

Design Challenges use the Design Cycle as a framework for problem-solving. The Design Cycle is a process that promotes innovation through seven stages: 1) identify the problem; 2) brainstorm and research; 3) develop a solution; 4) construct a prototype; 5) test and evaluate; 6) share; and 7) iterate. These stages do not necessarily need to occur in order and students should feel comfortable returning to any stage at any given time. The goal of the Design Cycle is to promote creative thinking, both individually and collectively, and to generate new ways of approaching and solving problems. Note, the Design Cycle is applied across all coursework and not just work pertaining to a Design Challenge.

In order to facilitate this fluid movement between stages, teachers and students must create an environment that embraces failure as a necessary component of innovation. Learning how to overcome obstacles, while in an inclusive space, is a benefit of the Design Challenge. Students will inevitably face roadblocks in their lives, so helping them learn how to overcome setbacks contributes to Metro's mission of developing the student holistically.

Teachers play a crucial role in facilitating an effective Design Cycle. First, teachers should frequently reference and revisit the Design Cycle throughout students' work. Many students see an unsuccessful prototype as "failure" and have difficulty realizing the opportunities for growth. Having the Design Cycle as the framework for problem-solving creates an environment that is inclusive of setbacks and develops resiliency. Second, teachers should act as impartial sounding boards or advocates to help students identify potential issues with a theory or solution. Last, teachers should encourage students in moving forward with their design and problem-solving as a group.

Figure 3 and paragraphs following provide the format and flow of the Design Cycle.



Figure 3. The Design Cycle

Stage 1: Identify the Problem

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Students must have a clear understanding of the problem they are trying to solve and who they are trying to solve it for before they can develop effective solutions. This understanding includes defining all required criteria, constraints, variables, and constants. The length of time students spend in this stage will vary depending on the complexity of the problem. Sample questions to ask during this stage include:

- What is the root/core problem?
- Who is the solution going to help?
- How does this problem relate to the student's other classes?
- What are the constraints of the problem?
- What is the counterfactual?

In order to proceed, students should have a clear and common understanding of the problem.

Stage 2: Brainstorm and Research



Once students understand the problem, they can proceed with brainstorming and researching. There is a strong emphasis on "quantity over quality" during this stage. The goal is for students to gather their ideas on paper and begin to quantify their solutions while avoiding bias at all cost. Note, a well-defined problem will often have multiple viable solutions, so students should be encouraged to explore different ideas than their peers. The brainstorming stage does not need to lead to a single, solidified

idea. Students can produce fractions of ideas to later piece into a final solution.

Sample questions to ask during this stage include:

- How does this idea contribute to the solution?
- Is the student keeping the user, audience, and all constraints in mind with each solution?
- What prior work has been done on this exact problem?

In order to proceed, students should have identified various potential solutions they would like to explore.

Stage 3: Develop a Solution



In this phase, students must identify a primary solution based on prior feedback. How they frame their solution provides the framework for the rest of their design.

The important phrase in this step is, "be the scientist, not the salesman." Students should attempt to develop the best product possible, not justify any portion of the product.

Students should be encouraged to accept feedback as product-based, not person-based, which can be difficult, but accepting this kind of feedback is a valuable skill that students can practice at this step in the process. During the feedback loop, teachers should encourage students to provide feedback in quantifiable ways to reduce biases.

Sample questions to ask during this stage include:

- What is the timeframe for this solution? Is it reasonable?
- Does the solution consider all the user/audience's needs?
- Is this the best viable solution?

In order to proceed, students should gather constructive feedback on their solution.

Stage 4: Prototype



During this stage, students are expected to create a prototype and develop a product, which is typically the longest phase because it involves students building their solution from a concept to product.

If students thoroughly developed their process in the previous stages, the prototyping stage should be relatively straightforward. Students will encounter complications,

unexpected issues, and accidents that will force them to adapt. Reemphasizing the necessity of failing forward in the Design Cycle becomes important at this stage.

Throughout this step, students should be able to work autonomously and with minimal teacher support. Teachers should be available for assistance when students seek additional guidance, but should still allow students to make their own decisions on how to proceed. Students often lose sight of the core problem at this stage. Teachers may find it useful to remind students about the target audience and the essential problem that they are trying to solve.

In order to proceed, students should have a near-final version of their prototype or product.

Stage 5: Test and Evaluate



In this phase, designers verify and quantify the success of their product or solution through testing. Based on the test's outcomes, it may be necessary to return to a prior step or to restart altogether. Students will spend 50% or more of their Design Cycle pivoting between Stages 4 and 5, which can also be a time to draw conclusions if the design leads to an open-ended solution.

If possible, designers should reach out to their audience and evaluators for feedback. These individuals can include teachers, peers, and real people outside of the school who deal with this problem. At this time, it is important to revisit the previously established constraints and ensure the product appropriately addresses the constraints.

In order to proceed, students must prove the validity of their product in a quantifiable manner.

Stage 6: Share



This stage is an opportune time to focus on the soft skills and Metro Habits needed for STEM Literacy. Students should informally check in with other groups to spark additional ideas or find solutions to common roadblocks, which will likely be a natural occurrence without intervention from the teachers.

Students should formally present their solution to an authentic audience at the end of the cycle. This audience can include peers, community members, teachers, and/or

professionals in the subject at hand. For example, for a public transportation Design Challenge, students can present their idea to representatives from an automobile manufacturer and the local public transportation management company.

In order to proceed, students must present the problem, their solution, and the rationale of their approach to an authentic audience.

Stage 7: Iterate



The Design Cycle does not occur in a linear fashion. Students may need to share and present ideas multiple times throughout the process to gather feedback and evaluate their solution. The ability to recognize the iterative nature of design is extremely important and often overlooked.

The teacher's role should be to facilitate the phases. Keep in mind teachers and students can return to any stage at any time during the Design Cycle – teachers should encourage students to return to previous stages when appropriate.

Most Design Challenges end at this stage, but the Design Cycle never truly ends – everything can be iterated upon ad infinitum. Although a student may have completed the assignment, the concept behind the Design Cycle should continue on into future work.

Rubric

To ensure equality and fairness in evaluation, teachers should collaborate to create a standard rubric for grading Design Challenges. Table 2 includes a sample rubric to evaluate student groups throughout Design Challenges. The rubric has been divided into "Mastery," "Work in Progress," and "Not Present" to give students a clear, objective perspective on their work.

Table 2. Design Challenge Rubric

Category	Mastery (5 points)	Work in Progress (3 points)	Not Present (0 points)
Knowledge of Problem/ Background Research	Students have a thorough understanding of the problem with evidence from four to five legitimate sources to support their thinking.	Students have superficial knowledge of topic, cited research or listed basic statistics from fewer than four sources, cannot answer questions, and lack specific mention of areas of opportunity.	Students have shown no knowledge or research of the issue beyond identifying the problem.
Area of Focus/Research Question	A specific aspect of the problem is identified. Previously proposed solutions are used as evidence for why this focus was chosen.	Problem is too broad or area of focus is unclear. Insufficient evidence is given for choosing area of focus.	Research question is not addressed. There is no focus of the project.
Potential Solution	The proposed solution is meaningful, evidence-based, and directly addresses the research question. Students attempt to problem solve in their solution creation.	The solution addresses the research question, but no research has been done on novelty of idea. Some clear problems exist with potential solution, or clear solution is not discussed.	The solution does not address the problem, has not been researched, or has numerous obvious flaws with implementation.
Visual	Visual is aesthetically appealing and able to be understood on its own. Visual is used as aide to the presentation.	Visual is <i>either</i> visually appealing <i>or</i> informative, but not both. Visual may have errors.	No visual, or visual is poorly made and shows a lack of effort.
Presentation	Students maintain eye contact, use appropriate body language, speak loudly and clearly. Presentation has obviously been rehearsed. All students participate in the presentation equally.	Students explain information on visual, but presentation is not well rehearsed. One or two students dominate the presentation.	Students read from slide and offer no more information. Presentation is incoherent and has not been rehearsed. One student presents.
Research	Correct APA format used to give credit to research. Sources are recent, credible, and related to student research and ideas.	Reference list is mostly formatted within APA guidelines with a few small errors and references are superficial to project idea.	No credible sources are referenced in APA format.

Summary

STEM Literacy is a Guiding Principle that emphasizes and embodies the alternative acronym of STEM: *Strategies That Engage Minds*. STEM Literacy is the intersection of traditional STEM subjects and working to develop 21st-century skills like creativity, communication, and collaboration to positively impact the world.

The Core Practice that most explicitly demonstrates students' STEM Literacy is the **Design Challenge**. A Design Challenge is a nine-week, multi-phase, cross-curricular project that challenges students to work in teams to solve a real-world problem. Design Challenges are most effective when the problem is relevant to students' interests and lives, addresses a problem in the local community, and creates partnerships between students and community members. Additionally, the Design Cycle, the cornerstone of the Design Challenge, is a process with which teachers, students, and administration should become extremely familiar and comfortable. Creating a culture where students can embrace both successes and failures to identify, create, and iterate is crucial to a successful Design Challenge.

Guiding Principle 3: College and Career Readiness

Guiding Principle: College and Career Readiness

Core Practices

- The Metro Habits
- Internships
- Early College Experiences

Overview

Though often framed as the finish line, students do not spend over a dozen years in classrooms just to earn a diploma. While a diploma represents a



student's readiness for the next step in life – whether that is a four-year university, trade school, military service, or entering the workforce directly – it should also mean a student has the skills they need to succeed in life. Metro aims to develop those skills and habits so when students earn a Metro diploma, they are prepared to impact the world as a STEM-literate citizen.

Most Metro students complete their high school graduation requirements in their Junior year. With the additional time, they can find Internship opportunities with local businesses, begin early college coursework, and continue to cement their Metro Habits inside and outside of the classroom.

The following Core Practices were designed in response to research on the effects of early college high schools. In 2014, Jobs for the Future and The Bill & Melinda Gates Foundation's Early College High School Initiative found that early college students are more likely to earn a diploma, enroll in college immediately after high school, and persist through their first year of college than similar students at traditional high schools. The Metro Model uses ECEs to support students while they earn their first college credits.

However, students need much more than "book smarts" to excel in college coursework. To address the soft skills necessary for success after graduation, professors at The Ohio State University collaborated with Battelle to establish the Metro Habits. From their first day at Metro, students practice the habits necessary for a successful career and college experience after graduating from Metro.

For the Metro Model, College and Career Readiness is central to a student's ability to live a self-directed life after graduation.

Core Practice: The Metro Habits

Components of The Metro Habits:

- The Six Metro Habits
- Habits and Discipline

The Six Metro Habits

The Metro Habits of Heart and Mind, known as the "Metro Habits," are six behavioral practices all students and staff are expected to demonstrate daily, inside and outside of the classroom, from the first day through graduation and beyond. The Metro Habits are integrated into every aspect of the Metro Model to create a community around shared core values. The habits are an essential tool for collective accountability, productivity, and inclusivity.

The habits also help to develop students beyond academic standards. Metro aims to develop students in a holistic manner. The habits act as the glue throughout the entire Metro Model.

Table 3 lists the six habits and their "I can" statements. These statements are a tool for students to take the habit from concept to practice and identify how that habit applies to their daily lives.

	Table 3.	The	Metro	Habits	of Heart	and Mind
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Habit	"I can" Statement
Effective Communicator	I can communicate my ideas clearly and can reflectively consider others' ideas even when those ideas are different from my own.
Critical Thinker	I can be a creative thinker, approaching new and perplexing problems with positive energy, uniqueness, and originality of thought, drawing from my own personal experiences and prior knowledge.
Effective Collaborator	I can work independently and as a contributing member of a team, accepting and reacting to improve myself based on feedback and critique, and demonstrating compassion and honesty in all interactions with others.
Engaged Learner	I can exhibit persistence, sustaining a problem-solving process over time while remaining focused and producing multiple drafts, to achieve success.
Inquiring Learner	I can be an inquisitive thinker, not only asking questions, but acting upon those questions to discover the answers, accepting confusion, uncertainty, and the risk of failure as part of the process.
Active and Responsible Decision Maker	I can make decisions rationally and purposefully, considering all available alternatives in order to find the best possible course of action.

Habits and Discipline

Habits do not emerge on their own. Staff must support students in developing their habits before they enter a college campus or workplace. In high school, the stakes are lower, and thoughtful intervention is essential.

Metro intentionally structures its discipline protocol on self-reflection and the Metro Habits. For example, when students are assigned lunch detention, they must fill out a reflection form that includes the Metro Habits (Figure 4). Students must explain the event, how it affected others, and the habit(s) they did not practice. Sometimes students will reflect with a school counselor to more fully understand the root of the issue. The reflection helps students understand their choices, the core issue at hand, and make a commitment to change in the future.

As mentioned in Design Challenges, it is important to create a culture where failure is embraced as a means of growth. When a student makes a poor choice, it provides an opportunity for development, not a time to indiscriminately punish a student.

This framework – reflecting and leaning on the Metro Habits – is also used to communicate with parents to help them understand and support these same issues in their home life.

Core Practice: Internships

Internships are the first opportunity for students to demonstrate the Metro Habits in a professional context outside of the school. This experience is open to students who

S Directions: Take time to fill o What happened?	tudent Reflection Form ut this reflection thoughtfully. Th parents and your office file.	is will be copied for you
Directions: Take time to fill o What happened?	ut this reflection thoughtfully. Th parents and your office file.	is will be copied for you
What happened?		
	C.	
How did it affect the other stu	dent/our school/the class/the tea	acher?
	12	
What Metro Habit did you not	practice? Circle all that apply	
Effective Collaborator	Active and Responsible	Inquiring Learner
Engaged Learner	Decision Maker	
Critical Thinker	Effective Communicator	
What can you commit to doing	g in the future?	
l will		

Figure 4. Example Student Reflection Form

have not yet begun their ECEs, during either the Spring or the Fall semester.

As a Core Practice, Internships are less complex than ECEs. Internships provide a stepping stone for students to build their skills and habits in a professional context. While ECEs are a year-long experience with many individual parts, Internships are simply a real experience of the working world.

In the Metro Model, students must find their own Internship opportunity, which challenges them to take initiative to reach out to local businesses and educational institutions that interest them, using some of the Metro Habits along the way. Because this experience is led by the student, their experiences range widely in discipline and rigor. From religious organizations to local hospitals, students make valuable community networking contacts and gain hands-on experience in a professional environment.

Metro has a few general guidelines for students participating in Internships. Students must spend at least 60 hours working for their business or community partner (the schedule is determined by the student and the Internship Host). There is no major paper or presentation requirement, but students must report back to the Internships Coordinator about their use of the Metro Habits and interacting in a professional context.

Through a small Internship experience, students make valuable community networking contacts and can put their habits into practice. These experiences are available to students before their Gateway during either the Fall or Spring semesters.

Core Practice: Early College Experiences

Components of Early College Experiences:

- Fall Semester
- Spring Semester
- Administrative Considerations

Early College Experiences (ECEs) are pre-college pathways into specific fields built to support a student's transition from high school to higher education. ECEs are not one specific course or activity. Rather, ECEs are a collection of experiences that prepare students for college.

A key objective of ECEs is to support students through their first college experience while developing their Metro Habits. Developing these skills with a cohort of peers gives them a social safety net while engaging in early college coursework.

ECEs take place over an entire academic year. When a Junior or Senior (sometimes a Sophomore) completes their core high school requirements and passes their Gateway, they are eligible to enter an ECE. There are two Advisory options for an ECE depending on the student's grade. Juniors enter ECE Advisory and Seniors enter Senior Communications. More details on the distinctions are included in the sections below.

Metro has five ECE pathways from which students in either grade can choose: Bodies, Energy, Growth, Design, and Digital. Once in an ECE, students attend college courses on campus, as a cohort working alongside undergraduates. Simultaneously, students are participating in rotations during the Fall semester to meet potential mentors for their Capstone in the Spring. After completing their Capstone, they become full-time college students for the remainder of their four years in high school.

The sections below provide further information on the activities that take place in ECEs throughout the year.

Fall Semester

Fall semester is dedicated to onboarding students to ECEs. During this time, students establish their ECE cohort, attend rotations, interview with mentors, and take their first college course.

Advisory: ECE Advisory and Senior Communications

Advisory in ECEs differ from previous Advisory experiences in the Metro Model. All students in ECEs continue to attend Advisory, but it is based on grade level. Juniors and below attend ECE Advisory. Seniors attend a different Advisory called "Senior Communications."

Students in their Junior year or below join an ECE Advisory with their ECE cohort. ECE Advisory meets twice a week for 45 minutes in the morning. This Advisory focuses on exploring careers and college programs of interest, resume writing, and a group-service learning project (which connects to the subject area of the ECE). Examples of projects include developing products for a homeless teen shelter, holding engineering and STEM workshops for elementary school students, and painting a mural for a neighborhood. Once a week, ECE coordinators meet individually with advisees to discuss progress, provide help managing their workload, and supply resources to support their success.

Students in their Senior year join Senior Communications, which is not in addition to an ECE Advisory, but in place of it. This course focuses on college applications and high school graduation requirements. While it does separate some students from their ECE cohort, Seniors are better served by this course to prepare them for matriculation after graduation. Students receive support filling out college applications, applying for financial aid, and finishing any remaining graduation requirements for high school.

Additionally, during Fall semester, ECE Advisors for both grades survey students to identify interests for Capstones so the administration can make appropriate placements for Spring. By early November, ECE Advisors should have a list of possible Capstone placements.

At Metro, all students in an ECE (regardless of grade) must complete 30 group-service learning hours, 40 individual service-learning hours, and two college visits by the end of Spring semester.

While students may be placed in an ECE Advisory or Senior Communications, the following sections apply to all ECE students unless otherwise noted.

Rotations

Rotations are a series of speakers and site visits for students led by the ECE Advisor. This course exposes the students to as many colleges, careers, fields of study, and professionals as possible. Speakers are typically professionals across various fields, and site visits often coincide with locations that will host a Capstone student, like a hospital or an engineering firm. After each Rotation event or activity, students must write a reflection. Rotations provide an opportunity for students to receive a small sample of a career field before committing to a Capstone project.

Rotations are not a scheduled course. Rather, Rotations are an ad hoc set of events and activities that are embedded into a student's school schedule. Rotation activities occur at various times, depending on the speaker or the site, during Spring semester.

Selecting a Capstone Mentor

Students must be partnered with a mentor in the field for their Spring Capstone. To identify a mentor, ECE Advisors tap into their existing professional network or create new connections during the Fall semester. Then ECE Advisors accompany students on an interview with their potential mentor. The ECE Advisor should attend for the first few minutes to introduce each person and clarify the nature of Capstone and mentorship. Then the ECE Advisor should leave to allow the student and mentor to have an authentic conversation. If the student and mentor believe that it would be a worthwhile relationship, then they move forward. If not, the process starts over.

High School and College Courses

Students take at least one course on the high school campus that applies to both their graduation requirements and the theme of the ECE. For example, if this is a Math or Engineering focused ECE, then students might study Calculus.

Students also take one college course with the support of their ECE cohort. Typically, this is a low-level course that serves as a prerequisite for a future major. This aspect of the Metro Model requires high school and university administration to work closely together and communicate efficiently. The university partner must have enough seats for all students in the cohort, but the course must also be approachable enough so students' first experience with college is not demoralizing.

Spring Semester

The Spring semester focuses on additional early college coursework and the Capstone. For Juniors, this semester serves as their final semester as a traditional high school student. After completing their Capstone, these students spend their Senior year taking college courses on a local university campus and attending Senior Communications at the high school campus. For Seniors, finishing Capstone serves as their means to graduating high school.

Advisory: ECE Advisory and Senior Communications

Spring semester Advisory (ECE Advisory and Senior Communications) is designed to support students as they complete rigorous college coursework and their Capstone project. During this time, students will also be completing and participating in scientific writing seminars led by all ECE Advisors.

Scientific writing seminars take up two hours a week during Advisory. At this time, Capstone groups meet as a cohort to complete their Capstone assignment while building their professional skills.

The seminars begin with various topics like conducting proper research, writing professional emails, and communicating with mentors. Seminars also cover writing topics such as writing for an audience, writing with precision, and avoiding ambiguity.

These seminars also serve as the hub for students to find help from peers, share their successes, and handle the logistics of Capstone.

Throughout the semester, all students send weekly emails to their ECE Advisor and mentors to flag potential issues and successes.

College Courses

Students continue taking college coursework in the Spring semester. However, since students have already completed one college course, they increase their course load to two or three college classes as a cohort.

Capstone

Capstone is a course where students take ownership of a large project and work directly with a mentor. This mentor is typically a professional in the student's potential career field. This project is studentdirected and serves as the culminating project of their ECE and high school career. Capstone is an opportunity for students to demonstrate the Metro Habits and the knowledge they have learned in their coursework. A quality Capstone proves that a student can succeed with a full-time college schedule.

Capstone is also an opportunity for the student to network outside of Metro. If the experience is successful, students will have someone in the industry to serve as a resource for future applications, reference letters, mentorship, and collaboration. Some students may even continue to work with the professional throughout college and be hired on full-time upon graduation. At Metro, students must record 120 hours of work for their Capstone during the Spring semester. Ideally, at least 50 of those hours should be in person with the mentor.

There are two primary tracks for Capstone: Research and Applied. Students typically complete Research Capstones in laboratories by directly supporting an ongoing research project. Students who choose the Applied Capstone can either run a self-directed project or contribute to a bigger company endeavor. An Applied Capstone is like an Internship or an engineering co-op, while Research Capstones are closer to medicine or academia. Research Capstones require a research paper, while Applied Capstones require an engineering report.

For both Capstones, students are expected to complete a final product such as a research poster, tangible item, or prototype. The final products are displayed in a conference-style poster session where students apply their content knowledge, Metro Habits, and professional skills to present their work. A formal judging session takes place at an after-school event where their mentor, along with two other judges (e.g., professionals in the field), assess their project.

Through Capstones, students should demonstrate professionalism and strong communication skills in a work environment, present a formal proposal to solve a real-world problem, gain content-specific expertise within a field of interest, execute a Design Cycle to create an authentic solution to a problem with their mentor, and present it in written and verbal form.

The biggest difference between the Capstone and Internship is the Capstone's increased emphasis on research and problem-solving. Internships serve as a small evaluation of a student's professionalism. Professional skills are then refined when completing a Capstone, with a larger focus on the application of the engineering design process or the scientific method.

At this point, students complete their ECEs. Most students have met all their graduation requirements and do not have any more classes to take at Metro. Seniors will graduate in the Spring, while Juniors spend their Senior year taking college courses.

Administrative Considerations

ECEs are the most robust and challenging part of the Metro Model's Core Practices, both for students and administrators. The following are a few suggestions to assist with implementation.

Learning Objectives and Advisory Panels

Due to the nature of these programs, Metro's learning objectives are loosely tied to national standards. All ECEs somewhat follow Ohio's Career-Technical Education (CTE) standards, but not explicitly. The goal of CTE standards is tied to career centers and aims to prepare students for careers in their fields immediately upon graduation. Metro's goals are more closely tied to colleges, not career centers, so Metro's standards have a slightly different focus.

Metro's learning objectives are developed by each ECE Advisor and modified based on feedback from the industry. The main vessel for feedback is the ECE Advisory Boards. Each ECE has an Advisory Board of industry partners who help guide the content and rigor of the ECEs to ensure the objectives align with the necessary skills for the field.

Flexible Scheduling

The Core Practice of Flexible Scheduling becomes more of a challenge when college credit coursework is introduced. For example, an administrator may be scheduling students for Calculus in high school or Statistics in college, while other students are not attending any Math classes.

In the Spring, students' Capstone schedules are influenced by both college courses and Capstone since much of their Capstone work will take place off-site. Therefore, ECE Advisors must have a flexible schedule so they can work around a student's schedule to meet with them individually.

Relationships with Academic Advisors

Metro has a dedicated Academic Advisor at its partner university, The Ohio State University. This person plays an integral role in ECEs and is vital to maintain effective relationships with university partners.

The University Advisor has an office at Metro and students complete all their scheduling with this individual. Having an Advisor who bridges Metro and the university helps with the coordination of ECE students because they have a holistic view of the schedule and courses at both locations. The Advisor also helps with college orientation logistics such as obtaining an email address and student ID, navigating campus, and leveraging university resources.

ECE Advisor Duties

Each student in an ECE has three roles: high school student, college student, and professional. Likewise, ECE Advisors serve in roles of an Advisor, teacher, college liaison, and networking advocate. Some examples of these duties are outlined below.

- *Classroom Teacher:* At Metro, each ECE Advisor teaches two courses and Advisory in the Fall, and Advisory and Capstone in the Spring.
- College Liaison: The ECE Advisor is the liaison between the student and the student's college
 professor(s). The difference between the Academic Advisor and the ECE Advisor is that the Academic
 Advisor provides support for the overall college experience while the ECE Advisor solely serves as a
 liaison between the student and college professor. The ECE Advisor should be aware of how the
 campus operates and should be able to help guide students to the university resources.
- Networking Advocate: Metro is closely connected with many businesses and community members who want to support the school. Metro's ECEs collectively have 30 to 50 people that Advisors regularly connect to collaborate. The ECE Advisor is responsible for contacting and connecting with these individuals as well as maintaining existing relationships. Remember, it is important to establish and foster these relationships so students have plenty of options and opportunities for their Capstones and

rotations. Allocating two to three hours a week for the teacher to perform this task is vital to the success of the ECE.

Timeline

Table 4 provides a general timeline to help guide ECEs through the school year.

Timeframe	Activities				
July - Early August	ECE Advisors contact previous mentors to reconnect and seek out potential new mentors for rotations.				
Late August - October	ECE Advisors continue to contact mentors while students visit mentors and Rotation sites.				
Early October	ECE Advisors survey students to identify interests for Capstones so administrators can make appropriate placements.				
Late October - Early November	Based on student feedback, ECE Advisors contact mentors for Capstone projects. By early November, ECE Advisors should have a list of possible Capstone placements.				
Early November	Administrators publish Capstone lists and placements. Administrators can either assign mentors directly or allow students to choose by listing their preferences.				
Early November - December	ECE Advisors accompany students on interviews with their potential mentors.				
Winter Break	Students contact their mentor to identify next steps and any prerequisite training and/or materials.				
January - Late April	Students work toward completing their Capstone and continue to meet with their ECE Advisor every other week. Students attend scientific writing seminars.				
Middle of May	Students present at the Capstone symposium.				

Summary

Metro aims to prepare students through the Core Practices of The Metro Habits, Internships, and ECEs. The **Metro Habits** are six behavioral practices all students and staff are expected to demonstrate daily, inside and outside of the classroom, from the first day through graduation and beyond. The Metro Habits serve as the cornerstone of the Metro Model and should be a guide for many assignments, discussions, and activities. **Internships** provide an opportunity to bring those habits into a professional context. Students can receive a sample of the real world, realizing for themselves how the habits are applicable outside of the school day. **Early College Experiences** are sets of activities that teach students how to effectively work in teams and expose students to the dynamics and expectations of life outside high school.

The crux of the Metro Model is rooted in **College and Career Readiness** and aims to holistically develop students to prepare them for success in college, their career, and beyond. Together, these three Core Practices simulate life in the real world, but allow students to adapt to these new environments with the social safety net of Metro's support.

Guiding Principle 4: Student Autonomy

Guiding Principle: Student Autonomy

Core Practices

- Portfolio
- Roundtable
- Gateway

Overview

The Core Practices within Student Autonomy prepare students to independently navigate the real world. While many components of the



Metro Model reinforce and develop Student Autonomy, this Guiding Principle focuses on three Core Practices where students display high amounts of autonomy: Portfolio, Roundtable, and Gateway.

Through these practices, students receive constant feedback from their peers and Advisors to further develop their Metro Habits. They must also affirmatively demonstrate and communicate how they embodied the habits every semester. They must reflect on their own growth and build their own goals for the future.

Navigating the transition from high school to college can be a challenge for traditional college Freshmen, even more so for high schoolers attending college courses. High school students must have fruitful habits and skills in order to excel in a college environment, and developing their autonomy is essential to their success. Through these Core Practices, Metro aims to prepare students to succeed in their college years and beyond.

Core Practice: Portfolio

Components of Portfolios:

Portfolio Structure

Overview

As noted under the Core Practice of Advisory, students are introduced to the Portfolio in middle school and continue to build its content throughout their high school career. The Portfolio is a collection of a student's experiences and accomplishments throughout their entire Metro Journey and serves as the central curriculum for Advisory. Portfolios also serve as a foundation and reference for additional Core Practices under Student Autonomy.

The Portfolio has three primary functions. First, it guides Roundtable presentations two times a year, capturing student experiences while still fresh in their memory. Second, it guides Gateway presentations as evidence for college success. Third, it captures exemplar material from their high school experience to support their college applications.

Structure

Student Portfolios are easiest to manage in a digital form, as students compile reference documents throughout their time in middle and high school. Metro uses a Google Site to host students' Portfolios. The site is separated into a different page for each year. The same elements make up the backbone of both Roundtable and Gateway presentations. Figure 5 shows an example Student Portfolio for the Year 2 Sophomore experience.



Slide Deck

Figure 5. Example Student Portfolio for the Year 2 Sophomore Experience

The slide deck is the

foundation of their presentation for Roundtables and Gateways. In Freshman, Sophomore, and Junior year, this slide deck includes information that highlights personal growth, academic performance, and strategic planning.

For the personal growth section, students must provide evidence of assignments related to individual growth from their Advisory class. For each example, they must provide a brief caption explaining how the assignment helped them grow.

For the academic performance section, students must provide evidence of mastering content and using the Metro Habits in each class of the semester, which includes their final grades and a short reflection on both a Metro Habit they demonstrated well and one that needs improvement.

For the strategic planning section, students must provide evidence that they are prepared to be successful as a professional beyond high school, which includes Advisory assignments about strategic planning, college visits, schoolwide presentations, real-world experiences, and more. Each example must include a brief caption explaining how it contributed to their strategic planning.

School-Year Thesis

Students must write a short synopsis of their school year through the lens of their Metro Habits. This synopsis includes highlighting a few habits that are growth areas for them as well as habits they excelled in during the year.

Service-Learning

Students must provide images from their service-learning experiences along with a service-learning log notating their cumulative service hours. They must also include an explanation of what they did, why they did it, and a short reflection on how their service-learning experiences impacted their high school experience.

Signature Work

Students must choose one signature work that best demonstrates their learning from one year of school. When filling out college applications as upperclassmen, these examples are often quite useful for

Student Autonomy

students. Remember, students from Metro are applying to academic institutions that likely do not use the Mastery grading scale. Therefore, having additional works is a useful supplement to a college application.

Core Practice: Roundtable

Components of Roundtable:

- Roundtable Structure
- Implementation at Different Grade Levels

Overview

The Roundtable is a structured, student-led conference where students present their Metro experiences and future plans to a parent/guardian and their Advisor. This presentation focuses on two main pieces: identifying a student's successful habits and setting goals for the coming semester. These presentations occur two times a year, at the end of the Fall and Spring semesters. After a student completes their Gateway, they no longer have to do a Roundtable.

Roundtables are an opportunity to reflect on their learning and use of the Metro Habits. This presentation is essentially the same at all grade levels, with increasing detail and personal reflection at the higher grades. The Portfolio serves as the reference and foundation for Roundtable presentations.

Structure

Roundtables occur over three whole days for middle schoolers. Allocating this much time out of class helps build social accountability around the presentations. At the high school, students have recorded their Roundtables on video in the past. At home, they give their presentation to their parent, follow the protocol, and then submit it to their Advisor for review. Implementation is up to the discretion of the school and their students' needs.

The desired outcome of Roundtables is for students to clearly identify their successful habits and future plans, while providing supporting documentation. The following parts of their presentation will provide evidence to support their answer.

Introduction (5 minutes)

Students introduce themselves and welcome the panel. The students oversee the Roundtable experience and must explain the goal of their presentation in their own words.

Presentation of Work and Demonstration of Progress (20 minutes)

Students present evidence of growth for each of their Metro Habits using their Portfolio website as a presentation aid. They do not have to cover every piece of detail on their website, but must address every Metro Habit with at least one example.

Conclusion (5 minutes)

Here, students explicitly answer the question, "What am I prepared to do?" Students can now support their answer with the evidence they shared in their presentation. Students summarize how the current year has prepared them for the next year. Students should declare a goal they plan to implement in the next year that will support their continued growth. This goal should emerge from the "strategic planning" section of their Portfolio.

Clarification and Extension (5 minutes)

This time is reserved for the panel to ask questions about the student's work. Often, panelists will ask questions about potential problems and obstacles in the future so students are aware they may be facing such challenges.

Panel Deliberation (5 minutes)

All students leave during the deliberation. The panel members decide whether students have met the expectations for a Roundtable presentation and deliver the results to students. If they have been met, then students receive Mastery for the Roundtable presentation. If not, they must find another date to redeliver their presentation for another attempt.

Core Practice: Gateway

Components of Gateways:

- Gateway Structure
- Checks and Balances

Overview

The purpose of the Gateway is to assess a student's readiness to successfully complete early college coursework. Gateway occurs when a student has, or is about to complete, 80% of the credits required for their high school diploma. For some students, this milestone could occur at the end of their Sophomore year. Others may take until their Senior year for their Gateway presentation. It serves as the last benchmark between a student and their ECE and functions like a Ph.D. defense to support their assertion that they are ready for college.

Like Roundtables, this presentation is also based on their Portfolio, but Gateways are much more robust. A student's panel must include their Advisor, parent(s)/guardian(s), a current first year student, a teacher/staff member, and at least one other adult outside of Metro that is significant to the student. The student must also choose a student advocate to read a short-prepared statement on their behalf that supports their transition to college coursework.

Students focus on addressing three questions in their Gateway presentation: 1) "Who are you now? 2) How have your Metro experiences shaped who you have become? 3) What are you now prepared to do moving forward into college?" Students must also have a thesis that supports the following statement: "I am ready for college coursework based on my time at Metro and what I am prepared to do."

Structure

Introduction (5 minutes)

Students introduce themselves and welcome the panel. They explain the goal of the Gateway in their own words and make their thesis statement.

Presentation of Evidence (25 minutes)

Students present evidence of growth for each of their Metro Habits using their Portfolio website as a presentation aid. They do not have to cover every piece of detail on their website, but must address every Metro Habit with at least one example. They should focus on their growth over their entire academic career at Metro, not just the past year.

Each piece of evidence will follow this general form: "I am ready to do ______ because I am _____. This piece of evidence, from ______ class/experience proves it."

Conclusion (5 minutes)

The student must explicitly re-address the thesis statement and summarize to the panel how their work at Metro has prepared them to represent Metro as a college student and professional colleague. The student should use elements from the "strategic planning" section to reference goals for their success in college.

Clarification and Extension (5-10 minutes)

The panel asks clarifying and probing questions about the presentation, evidence, and college preparation. The student advocate reads their prepared speech.

Panel Deliberation (5-10 minutes)

All students leave during the deliberation. If requirements have been met, then the student receives Mastery for the Gateway presentation. If not, they must find another date to redeliver their presentation for another attempt.

Summary

The Guiding Principle of **Student Autonomy** prepares students to independently navigate the real world without substantial support from teachers and parents. Student Autonomy is carried out through the Core Practices of the Portfolio, Roundtable, and Gateway.

The **Portfolio** serves as the foundation for the other two practices. The Portfolio guides Roundtable and Gateway presentations and captures exemplar material from their high school experience. The **Roundtable** is a structured, student-led conference where students answer the questions: "Who are you now and what are you prepared to do?" and the **Gateway** assesses a student's readiness to successfully complete early college coursework. All three practices require students to independently reflect, manage, and communicate their experiences in a way that shows they are ready for their next step. If a student seems unprepared to advance, teachers and administration should refer back to the previous Guiding Principles to explore ways to meet the needs of that student so the student has what they need to succeed.

Guiding Principle 5: Cultural Competency

Guiding Principle: Cultural Competency

Core Practices

- Nonselective Lottery Admission
- Culturally Informed Practices
- Social and Emotional Supports

Overview

Cultural Competency is the final Guiding

Principle in the Metro Model. For the purposes of



this document, Cultural Competency refers to a student's ability to confidently interact and solve problems with a wide variety of people in a wide variety of contexts.

This Guiding Principle is heavily reliant on a school's local context. The first practice, Nonselective Lottery Admission, ensure that the student body itself remains representative of the full diversity of a metropolitan region. In any given school, that student body will include students of different races, ethnicities, faiths, socioeconomic statuses, and educational pasts. Each student body is unique, but each must be supported.

School administrators may implement different interventions depending on the students they serve, but they all must hold Culturally Informed Practices and Social and Emotional Supports top of mind throughout the other elements of the Metro Model. Cultural Competency does not emerge from one class or event; rather, Metro integrates frameworks throughout the model that promote and develop Cultural Competency within students. Individual implementations may appear different, but all must be in service of providing students a holistic learning experience that can help them grow into a confident adult.

Core Practice: Nonselective Lottery Admission

Metro was founded in 2006 in part to solve the following problem: young women and students of color earn STEM degrees at much lower rates than young white men. Both Battelle and The Ohio State University believe that the world needs a diverse workforce leveraging every mind possible to solve the world's biggest problems. This idea means making a quality STEM education available to everyone, regardless of zip code or finances, and providing additional support to students who may not see themselves in a STEM career. STEM Literacy matters less if only a fraction of students can achieve access.

Too often, a student's future can be determined by their neighborhood. Students generally only have access to the school in their district of residence. Students from neighborhoods with higher socioeconomic statuses have access to generally higher performing school districts, while educational opportunities can be constricted for economically disadvantaged students.

The Metro Model changes this notion. Metro aims to increase access to quality STEM education for all students across the region's school districts through a nonselective lottery admission process for admission into either sixth or ninth grade. Students apply by the Spring before the beginning of the school year, then are chosen without regard for their test scores. The only aspect of their application that merits consideration is their district of residence, because 50% of Metro's seats are reserved for students whose district of residence is Columbus City Schools. The remaining districts in the metropolitan area are represented proportionally. All students who apply have an equal chance to attend Metro, without regard for finances, academic performance, or any other measure.

The student body of a Metro School should represent its surrounding region and not only enroll students of higher socioeconomic status areas. Through the nonselective lottery admission process, Metro ensures that the student population roughly resembles the demographics of the region at large. Students should spend their formative years closely collaborating with students that reflect the diversity of the entire metropolitan area, not just pockets of the suburbs or the urban core. A graduate of the Metro Model

should have the ability to confidently interact with a wide variety of people and a wide variety of contexts, going far beyond the neighborhood in which they live.

The Metro Model believes that STEM is for all students, and additional efforts must be made to ensure that students are not directly or indirectly filtered out due to their economic situation. Once they are part of the student body, then the following Core Practices contribute to their success.

Core Practice: Culturally Informed Practices

For students and adults to effectively collaborate in cross-disciplinary teams to solve problems, they must understand and respect one another. This process begins with the administration supporting and acknowledging the diversity of experience and background that an open enrollment school invites. As students learn to work together, they will be prepared to work in real-world teams.

The needs of a student body differ from school to school – no two schools serve the same students. If the Metro Model is to fully implement Personalization, then schools must be responsive to the unique cultural needs of their student body. Instead of ignoring differences between students, administrators should provide specific support to ensure those difference do not become barriers.

Students have a wide variety of religious backgrounds and cultural contexts. Some students may be the primary English speakers of their household and will need additional support when communicating important information to their parent(s) or guardian(s). Other students may not attend a church or a mosque and will need additional support when learning how to act in large group assemblies. Teachers may be unfamiliar with the needs of a population, so administrators must proactively give them the tools to support their students.

In general, if the school staff is not equipped to provide the support for large populations of their students, administrators must provide that support, which could mean additional language supports if there is a large population of English as a Second Language learners or additional religious considerations depending on the faiths represented.

For example, Columbus, Ohio, has the second largest Somali refugee population in the United States. Since Metro aims to represent the diversity of its entire metropolitan region, many students at Metro are Somali. The Metro School did not ignore this fact. Instead, administration partnered with an Ohio State University professor to train school staff about potential conflict between groups from Somalia, religious considerations, and answered questions to help staff better support and understand their students. Administration also hired teachers with Somali and Arabic language skills and redesigned school websites to allow for easy translation. Additionally, for J-Term 2019, Metro offered a class on African history and culture. The Metro Model is designed to enable administrators and staff to have the flexibility to embed Culturally Informed Practices that actively affirm students' experiences, cultures, and histories.

Not every Metro Model school will have a significant Somali population, but every school should identify the makeup of its student body and take the initiative to provide for the students it serves. A school centered on Personalization and an individualized learning environment will proactively provide for its students by properly equipping its educators with relevant cultural knowledge. As students see adults embrace more culturally inclusive practices, they will be compelled to do the same.

Core Practice: Social and Emotional Supports

The Metro Model aims to help students find their voices and confidently use them to communicate. Many students need additional support along the way to navigate their lives at school, at home, and in between. School is a central place for young adults to learn how to manage stress, understand their emotions, foster healthy relationships, and ask for help when needed. These coping skills can have enormous effects on the school environment and are central to a student's success in life after graduation. Accordingly, Social and Emotional Supports are integral to the Metro Model.

Like Culturally Informed Practices, Social and Emotional Supports are embedded throughout the Metro Model. The Metro Habits represent healthy ways to interact with the world and each other, reinforced by Portfolios, Roundtables, and Gateways. Advisory serves as a hub for students to foster positive relationships with peers and adults. A student's Advisor serves as an adult connection to the school, and the first person for which they should be comfortable bringing problems or struggles. In their Design Challenge groups, students are challenged to collaborate across differences to solve problems, which is a huge opportunity for social growth. Again, specific interventions should respond to the needs of the student body because they will be different across varying contexts and diverse student bodies.

Metro has realized success through offering yoga once a week during Advisory. This exercise provides an opportunity for students to center themselves with their physical presence, observing the mental and emotional effects that this consistent practice can provide. Metro has also realized success in using a "Zen Zone" for middle schoolers. Zen Zone is a room that has dimmed lighting, comfortable seating, and tools to help students learn to self-regulate. Students spend time identifying how they feel, taking deep breaths, and making a choice for how to handle that emotion. Additionally, counselors are available to work with students to talk through issues that are preventing them from learning in the classroom.

These examples should not be taken as gospel, rather as indications of administrators working seriously and earnestly to address students' social and emotional needs. These supports expand beyond just the administrator level. Teachers should have the autonomy to tailor their teaching and assessment to individual students. If a student struggles with writing, there are other ways to assess their Mastery of any given content. Teachers, due to their robust relationships with students, should be trusted to identify effective Social and Emotional Supports for their students.

Social and Emotional Supports are also found across all of the principles and practices to help students navigate the world and their own responses to that world. By developing skills to manage their feelings and responses to the world, students will become better collaborators and problem-solvers, both in their future professions and in their personal lives.

Summary

Cultural Competency runs through the Metro Model from the initial lottery admission through each of the Core Practices. The Core Practices for Cultural Competency are the Nonselective Lottery Admission Practice, Culturally Informed Practices, and Social and Emotional Supports. Schools should implement these practices in accordance with the needs of their own student bodies.

Nonselective Lottery Admission is the non-negotiable practice of enrolling students purely based on random selection and not academic performance or zip code. Nonselective Lottery Admission ensures the student body represents the region, prevents the school from becoming accessible only to students of high socioeconomic neighborhoods, and creates a student body of diverse backgrounds. **Culturally Informed Practices** supplement the Nonselective Lottery Admission process because with such a diverse student body, the school should be equipped to support the varying needs and backgrounds of students. It is imperative for a Metro School to understand the makeup of its student body and make the proper adjustments to meet the needs of its students at a Metro School will originate from varying backgrounds, and varying backgrounds produces different types of stressors. Having the available Social and Emotional Supports in place for students will help students be at their best, ready to take on the world's most complex problems.

Conclusion

From Mastery and Advisory to Roundtables and Gateways, there are many pieces to the Metro Model. Understanding the principles and practices in their own contexts is a start, but how do they cohere into a student's experience at school?

The following is an example of one student's path through the Metro Model.

The Student's Journey

Taylor is a fifth-grade student in the Columbus City School district. During Spring, Taylor heard about Metro at their local library, so their parents submit an online application to Metro. Taylor is selected in the lottery and decides to enroll. A couple weeks before Fall semester, Taylor participates in placement testing at Metro while their parents meet the administration to ask questions about the school. Based on the test results, administration uses Flexible Scheduling to build a schedule that best meets Taylor's educational needs.

Taylor spends their first few days of sixth grade in orientation. They are placed into an Advisory where they begin to learn about the Metro Habits. During their first Fall semester, they work on their Portfolio, acclimate to Mastery assessment, and present their first Roundtable before Winter break. Taylor returns to school in January for J-Term. During these five weeks, Taylor spends time remediating a class they did not master in the Fall and takes a few enrichment classes in areas of interest. In the Spring semester, Taylor returns to Advisory and works on their first Design Challenge. They continue to take high school classes, work on their Portfolio, and present their Roundtable at the end of the year. After Spring semester, Taylor remediates one class for a week until they achieve mastery. Taylor enjoys the summer, then follows this pattern for two more years of middle school.

Taylor has many Arabic-speaking peers, so school administration develops and implements Culturally-Informed Practices to better serve the student body. Taylor receives a variety of Social and Emotional Supports from the counseling staff, their Advisor, and school administration as they make their way into high school.

Taylor begins ninth grade by entering a new Advisory, taking a Study Skills class in the first semester, and continuing to present Roundtables at the end of each semester. After Fall semester, they participate in J-term, like before. In the Spring semester, they participate in another Design Challenge, then end the year with another Roundtable. Taylor follows the same path in tenth grade. In the Spring semester of tenth grade, they find an internship at a local architecture firm and spend some of their Spring semester learning on the job. At the end of their Spring semester, Taylor has completed 80% of their high school credits. They complete their Gateway and are prepared to begin their Early College Experience.

In eleventh grade, Taylor spends the Fall semester attending rotations to learn more about their options in ECEs. They take their first college class with a cohort of other Metro students and begin to earn early college credits. In the Spring semester, they take additional college courses and work with a mentor at the architecture firm from their internship. They present their capstone at the end of the Spring semester, completing their ECE.

In twelve grade, Taylor spends the entire year taking Senior Communications at Metro while taking college courses at the local university. Taylor graduates with 20 college credits, a high school diploma, and a great relationship with their mentor.

Figure 6 presents a graphic of the typical Metro Student pathway.

		1-2 weeks before semester	Fall Semester	J-Term	Spring Semester	Summer
Recruitment and Admission	5th		Apply to Metro		Lottery Admissions	
Middle School	6th-8th	Placement testing for new students	Advisory Roundtable	Remediation, Acceleration, and Enrichment	Design Advisory Challenge Roundtable	Remediation
High School	9th	Placement testing for new students	Advisory Study Skills Roundtable	Remediation, Acceleration, and Enrichment	Design Challenge Roundtable	- Remediation
	10th		Advisory Roundtable		Design Challenge Internship Gateway	
	11th		ECE Advisory Rotations College Course		ECE Advisory College Course Capstone	
	12th		Senior College Communications Course		Senior College Communications Course	
Graduation						

Figure 6. Metro Student Pathway

Moving Forward

"Our vision is to provide a small and intellectually vibrant learning community designed to serve students who want a personalized learning experience that prepares them for a connected world where math, science, and technology are vitally important. All Metro students engage in a personally relevant and academically rigorous curriculum within a safe and trusting environment." (Metro Schools, 2019)

Education is both an art and a science. Its complexities cannot be boiled down into one guidebook.

This guidebook represents the science, broken down into the principles and practices that produce remarkable outcomes for students in the Metro Model. For over a decade, the flagship Metro School has offered a hands-on, early college STEM education to students in Central Ohio. Regardless of their zip code or academic achievement, all students should have access to a quality, real-world STEM education. The Metro Model is one contribution.

This guidebook does not replace the art of education. It cannot capture the local particularities of each community, the unique capacities of every educator, and the infinite potential of every student. This guidebook should inform future attempts to offer robust, real-world STEM education to all students, not just some of them.

Battelle's slogan is "it can be done." No matter the challenge, it can be done, but not without a strong team. The students in classrooms today will quickly become the adults solving the world's largest problems. To work together, those adults will need to be effective communicators and collaborators. To think outside the box, they will need to be critical thinkers. To continue growing throughout their lives, they will need to be engaged and enquiring learners. And to choose what's most important, they will need to be active and responsible decision makers.

This is the Metro Model. Through it, Battelle hopes to give today's students a chance to become tomorrow's innovators.



Glossary

- Advisory: a class that serves as a home base for students and provides them with the opportunity to build community with their peers, focus on the Metro Habits, and foster a relationship with their Advisor.
- **College and Career Readiness:** a Guiding Principle that aims at developing a student's ability to live a self-directed life after graduation through exposure to real-world experiences.
- **Cultural Competency:** a Guiding Principle that demonstrates a student's ability to confidently interact and solve problems with a wide variety of people in a wide variety of contexts.
- **Culturally Informed Practices:** tailoring activities, operations, and discussions in a way that acknowledges and embraces different cultural practices.
- **Design Challenge:** a multi-phase, cross-curricular project that challenges students to work in teams to solve a real-world problem using the Design Cycle.
- **Design Cycle**: a process that promotes innovation through seven stages: identifying the problem, brainstorming and research, developing a solution, constructing a prototype, testing, sharing, and iterating.
- Early College Experiences (ECE): pre-college pathways that lead into specific fields and are built to support a student's transition from high school to higher education.
- **ECE Advisory:** the Advisory that students in their Junior year or below take to explore careers and college programs of interest, receive support with resume writing, and complete a group-service learning project.
- **Extension Class:** Offered as part of J-Term, Extension Classes are for students who achieved Mastery in their class. Extension Classes are project-based and are developed around a shared interest of the students and teacher.
- Flexible Scheduling: the structure that allows for Personalization at Metro. Flexible Scheduling is the act of scheduling courses in accordance with a student's skill level and not just their age.
- **Gateways:** a structured, student-led presentation used to assess a student's readiness to successfully complete early college coursework. Gateway takes place when a student has, or is about to complete, 80% of the credits required for their high school diploma.

- **Intercession:** Offered as part of J-Term, Intercession classes are for students who were close to Mastery (between 80-90%). Intercession provides students the time to remediate work from the Fall semester and work at their own pace to complete missing or unmastered assignments.
- **Internships:** a semester-long experience at a professional workplace for students to continue cementing their Metro Habits before their Gateway.
- J-Term (also known as "January term"): a five-week term after Winter Break that provides students with additional time to achieve Mastery in Fall classes. There are three classes that Metro offers during J-Term: Recovery, Intercession, and Extension.
- **Mastery**: a form of assessment that requires students to earn a 90% or above on an assignment or class in order to receive credit. Mastery ensures a student truly understands the material even if that means allowing more time for an assignment or class.
- **The Metro Habits:** six behavioral practices all students and staff are expected to demonstrate daily, inside and outside of the classroom, from the first day through graduation and beyond. The habits are effective communicator, critical thinker, effective collaborator, engaged learner, inquiring learner, and active and responsible decision maker.
- **Nonselective Lottery Admission:** a process that admits students based on random selection to ensure that all applicants have an equal chance of being admitted.
- **Personalization:** a Guiding Principle that acknowledges each student has unique needs and will need different supports. Personalized learning experiences tailor education to meet the needs of each student.
- **Portfolio:** a collection of a student's experiences and accomplishments throughout their entire Metro Journey that serves as the central curriculum for Advisory.
- **Recovery:** Offered as part of J-Term, Recovery classes are for students that scored 80% or below on their Mastery assignments. For Recovery classes, teachers plan the course to cover the core standards that were not mastered by students. These classes are smaller and include more personalized help.
- **Remediation**: the process students take to relearn content and skills that they have attempted but not yet mastered. Remediation allows students another chance to demonstrate Mastery of skills and content.
- **Rotations:** a component of ECEs that exposes students to as many colleges, careers, fields of study, and professionals as possible through series of speakers and site visits for students.
- **Roundtables**: a structured, student-led conference where pre-Gateway students present their Metro experiences and future plans by answering two essential questions: "Who are you now and what are you prepared to do?"
- **Senior Communications**: the Advisory that students take in their Senior Year. Senior Communications focuses on supporting students with college applications and high school graduation requirements.
- **Social and Emotional Supports:** the supports for students that aim to meet their unique needs around social and emotional wellbeing. Social and Emotional Supports help students be at their best at school, home, work, and beyond so they can engage in the Metro Habits.
- **STEM:** acronym for the subjects of Science, Technology, Engineering, and Math (traditional meaning). Metro also views STEM as *Strategies That Engage Minds*.
- **STEM Literacy:** a Guiding Principle that focuses on building students' understanding around the intersection of traditional STEM subjects and 21st century skills. STEM Literacy is largely developed through Design Challenges.
- Student Autonomy: a Guiding Principle that prepares students to independently navigate the real world.

Every day, the people of Battelle apply science and technology to solving what matters most. At major technology centers and national laboratories around the world, Battelle conducts research and development, designs and manufactures products, and delivers critical services for government and commercial customers. Headquartered in Columbus, Ohio since its founding in 1929, Battelle serves the national security, health and life sciences, and energy and environmental industries. For more information, visit www.battelle.org.

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