Introduction and Priorities: PREP-KC's **early-phase proposal** focuses on developing an evidence-based innovation that improves academic outcomes and increases STEM identity for high-needs students. The ***Real World Data Science (RWDS)*** **project** creates opportunities for middle school students from Kansas City's urban districts to develop data science skills and prepare for a STEM-focused career. The RWDS initiative will serve at least 750 students each year of the program and a cumulative total of 2,250 students. These students will attend ten middle schools across urban districts serving the Kansas City metropolitan area. Based on the demographics of our partner schools, we anticipate serving 600 high needs students each year, and a cumulative total of 1,800 high needs students. This project defines "high needs" students as students qualifying for free or reduced lunch, or identifying as Black, Indigenous, or Person of Color (BIPOC) student. Over the grant funding period, the proposed project will serve 10 schools and 2,250 students at a cost of $1,921 per student as well as thousands of teachers and students through our dissemination activities.

Participating schools will offer RWDS as a semester-long course for 8th graders. Throughout the course, students will solve data science challenges drawn directly from the Kansas City community and their personal interests. These real-world challenges anchor a curriculum focused on developing every student's identity as a data scientist and aligning data science instruction with critical math and science standards that will improve outcomes in STEM-focused coursework. RWDS will also incorporate STEM industry professionals into the RWDS course as advisors and subject matter experts for students. This ongoing interaction with STEM professionals develops students' awareness of STEM careers, builds their social capital, and provides exposure, support, and encouragement to boost student participation in STEM-focused pathways in high school.

PREP-KC has a track record of building strong partnerships with urban school districts across the Kansas City region. Since 2006, we have provided students with evidence-based college

and career preparation opportunities. Our evaluation partner for this project, MDRC, is a national leader in social policy and education research and has a demonstrated track record of successful evaluation activities on federally funded projects, including numerous EIR and I3 grants.

Absolute and Competitive Priorities: This project addresses **Absolute Priorities 1 (Demonstrates a Rationale)** and **3 (Field-Initiated Innovations—Promoting Equity in Student Access to Educational Resources and Opportunities: STEM)**. The project also addresses Competitive Priorities 1 and 2.

Competitive Preference Priority 1—Promoting Equity in Student Access to Educational Resources and Opportunities: Data scientists are overwhelmingly white and male, with BIPOC and female professionals working in data science roles (Drozda, 2021). The primary strategies for increasing access include providing an engaging curriculum and opportunities for students to build social capital as they interact with data science professionals on real-world data science. Additionally, intensive professional development and coaching for RWDS teachers will help them develop the capacity to teach data science in an engaging, culturally responsive manner.

Competitive Preference Priority 2—Addressing the Impact of COVID-19: Missouri and Kansas American Rescue Plan ESSER State plans confirm that school closures and other educational consequences of the COVID-19 pandemic disproportionately impacted low-income and BIPOC students (Missouri Dept. of Elementary and Secondary Education, 2021; Kansas Dept. of Education, 2021). RWDS' increased exposure to STEM-focused curriculum and prioritizing interactions with data science and other STEM-focused professionals also help close information and social capital gaps exacerbated by the COVID-19 pandemic.

A. SIGNIFICANCE

A.1.1 Significance- New Strategies: In the 21st century, the world has experienced a data explosion. As of 2018, 90% of the world's data had been created in the past two years (Marr, 2018). This data explosion has profound implications for our economy and our society. Data science professions, and more data science skillsets, are highly valued in the labor market. The World Economic Forum (2020) reports that the three highest-demand jobs globally are data analysts and scientists, artificial intelligence, and "big data" professionals, with 90% of companies planning to increase hiring in these areas globally. In the United States, LinkedIn reports that the number of data science roles has exceeded 30% yearly since 2017. Employers increasingly require data science skills for other high-demand, high-pay occupations (Berger, 2020). Across the Kansas City region, demand for data scientists and computer science-related positions exceeds national demand (U.S Bureau of Labor Statistics, 2021). Of the thirty occupations projected to have the fastest growth in the Kansas City region between 2020 and 2030, 12 require data science, analytics, or computer science skills (Mid-America Regional Council, 2020).

Young people will not only need to become data literate to compete in the workforce but also rely on data literacy skills to navigate and contribute to civil society. Individuals must be able to analyze data and gauge its validity when making critical decisions in their personal and civic lives (Engel, 2017). Absent comprehensive instruction on evaluating information and developing data literacy, research has demonstrated that the growing multitude of misinformation shared through social media and questionable sources can easily mislead young people and adults (Wineburg and McGrew, 2016). As LaMar and Boaler (2021) note, "It has become more important than ever for young people to learn how to tell fact from fiction, spot those who seek to peddle misleading information, and understand the data presented to them."

Despite this clear and growing need for K-12 students to develop strong foundations in data science, an Institute for Education Sciences panel focused on data science noted that data science education in the United States was in a "state of emergency" and at least ten years behind other countries (Drozda, 2021). Despite gradually increasing access to computer science coursework, 70% of 8th graders have not taken coursework for using, programming, or building computers (Drozda, 2021). The Data Science for Everyone Coalition at the University of Chicago gave Kansas a "D" grade and Missouri an "F" grade on data science policy due to minimal state standards focused on data science (Feng and Severts, 2022). None of PREP-KC's partner schools and school districts, which serve over 65,000 students, offer data science coursework in middle or high school.

RWDS provides much-needed new strategies focused on developing data literacy and core data science competencies for middle school students. The study of data science is an emerging interdisciplinary field in K-12 that integrates skills and techniques that include statistics, algebra, computer science, and communication (Thompson and Aratoopour, 2022). Data literacy incorporates "the ability to read, write and communicate data in context, including an understanding of data sources and constructs, analytical methods and techniques applied, and the ability to describe the use case, application and resulting value" (Panetta, 2021). By providing students with an authentic, engaging STEM experience in the 8th grade, RWDS will strengthen academic outcomes for students and provide immersive STEM exploration opportunities and an on-ramp to STEM pathways in high school and beyond.

A.1.2 Significance- Existing Strategies: The RWDS initiative builds on two well-researched and evidence-based strategies—**Project Based Learning (PBL) and Culturally Responsive and Sustaining Teaching (CRST)**. Each of these strategies has a robust research base documenting a

positive impact on students' academic, social-emotional, and college and career readiness outcomes. Evidence also indicates that these approaches provide powerful benefits for high-needs learners.

Project Based-Learning: PBL design principles emphasize the importance of the project as the central vehicle of instruction and students as active participants in the construction of knowledge (Condliffe, 2017). Researchers have found promising evidence that this instruction approach yields academic and self-efficacy benefits for students. A meta-analysis of published results on PBL (Chen and Yang, 2019) found that the approach had a medium to large effect on students' academic achievement compared to traditional instructional approaches.

Research studies show that students engaged in STEM project-based learning have higher gains in science achievement and perceptions of their STEM abilities (Education Development Center, 2015) and higher achievement in math (Han, Capraro, & Capraro, 2015; Scott, 2012). Deutscher et al. (2021) found that implementing PBL strategies in middle school science courses boosted academic achievement in science and other core academic subjects. Saavedra et al. (2021) also found that PBL boosts student achievement in high school Advanced Placement courses. In addition to the educational benefits of PBL, researchers have documented higher perceived efficacy (Chen, Hernandez, & Dong, 2015) and completion of more rigorous STEM programs (Scott, 2012). These outcomes are especially favorable for high-needs students who often started with lower domain-specific efficacy and achievement levels (Chen et al., 2015; Han et al., 2015).

Both data science experts and PBL practitioners have noted the complementary nature of PBL with data science education. A panel of data scientists recently noted, "data science appeals to students because of its focus on investigation; students can capture their interests from Harry Potter to human cells" (National Academies of Sciences, Engineering, and Medicine 2020, p. 58-59). At the same time, PBL practitioners who developed projects noted that publicly available datasets and the

wide availability of open-source data science tools allowed PBL practitioners to effectively develop rigorous and personalized data science projects (Finzer et al., 2018).

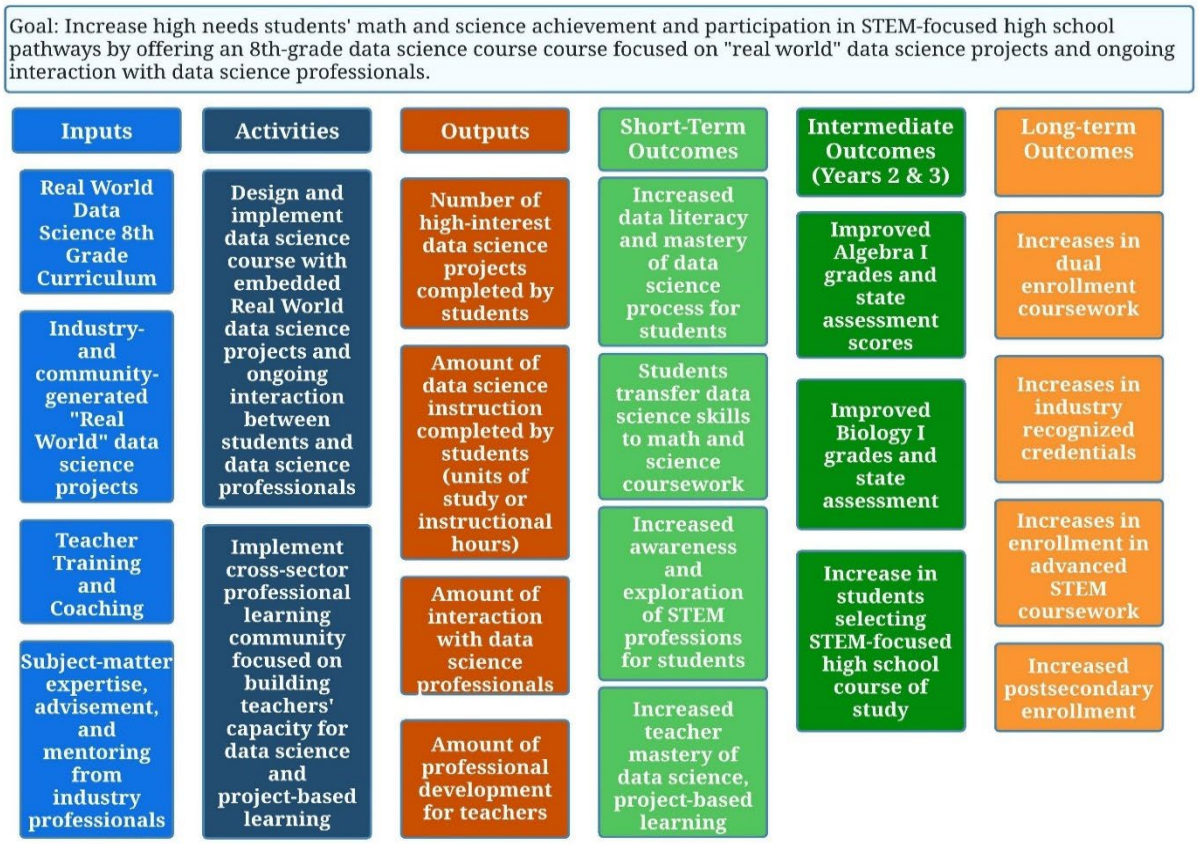
Culturally Responsive and Sustaining Teaching (CRST): CRST is a student-centered instructional framework that supports students—BIPOC students, in particular—in maintaining their language and cultural practices, which schools often marginalize in favor of dominant culture norms (Ladson-Billings, 1995). Researchers have correlated the implementation of CRST practices with academic achievement, improved attendance, and greater interest in school (Hammond, 2015; Muniz, 2019, Paris and Alim, 2017). When applied to STEM education and instruction, researchers have noted that reframing STEM as a vehicle for students to make social contributions to their communities can increase interest in STEM among BIPOC students (Lewis and Collins, 2001; Margolis and Fisher, 2000).

RWDS places students' interests and culture at the center of the course through student-selected and designed projects. Throughout the course, students will work on projects focused on selecting challenges to solve in their communities and data science projects focused on their interests. Additionally, students will have the opportunity to engage and interact with STEM professionals who grew up in the students' communities and, in many cases, are alumni of the same schools.

B.1 Project Design- Conceptual Framework: RWDS employs a multi-faceted conceptual framework designed to address barriers that limit the access, participation, and success of BIPOC students in STEM pathways during and after high school. This framework blends PBL and CRST pedagogy with a social-cognitive career development theory to address the academic, information, and opportunity gaps that prevent more high-needs students from participating and succeeding in STEM talent pipelines. RWDS leverages the following logic model to provide data science education

that meets the academic, social, and college and career planning needs during the critical transition between middle and high school.

RWDS integrates **four innovative design elements** to accomplish its goals—1) creating a **data science curriculum** for 8th graders; 2) structuring the RWDS data science course around **high-interest, authentic data science projects designed by local businesses and community organizations**; 3) integrating **ongoing interaction between students as data science professionals** into the course, and 4) supporting participating teachers through **a cross-sector professional learning community focused on building teachers' data science content knowledge and capacity for project-based learning.**



Design Element 1- an 8th-grade data science course: While efforts to create K-12 data science pathways are accelerating, there is a need to research effective data science curricula for students

before high school (Drozda, 2021). RWDS moves the focus on data science upstream to the 8th grade to maximize its academic, social, and college and career planning benefits for students. RWDS builds critical cognitive and academic foundations for students as they transition to advanced mathematics and science courses. The course will develop data literacy and data science competencies aligned with the following data science process outlined by the PRE-K to 12 Guidelines for Assessment and Instruction in Statistics Education II (GAISE II) report (Bargagliotti et al, 2020):

This process provides a learning framework that allows instructors to develop critical thinking, computational, and cross-content skills in math and science. By learning these concepts and applying them to their RWDS projects, students strengthen their skills across these domains and become more prepared to succeed in rigorous STEM coursework in high school.

Throughout the course, teachers will build essential data literacy and data science competencies aligned with each phase of the data science process illustrated above. Additionally, students will receive ongoing instruction in Microsoft Excel, Tableau, CODEC, and other software and technology platforms essential components of a data science toolkit. As students develop proficiency in these tools and the data science process, they will have the opportunity to earn micro-credentials and industry certifications that reflect their growing data science competencies.

Design Element 2: High-interest data science projects co-designed with local businesses and community organizations: The RWDS design team will co-create data science projects with students, local businesses, and community organizations. These projects require students to apply the data science process to high-interest, culturally relevant issues from their community and expressed interests. By making these projects the keystone of the RWDS course, students will apply their

understanding of data science to real-world problems, present their findings to community members and STEM professionals, and receive authentic feedback on their work.

Throughout the course, students will have the opportunity to work on between six and eight projects. Student-generated prototype projects developed by PREP-KC during the 2021-2022 school year focused on social justice issues such as gun violence and immigrant experiences in Kansas City and data related to personal interests such as favorite musical artists and movies. During the planning year, the RWDS design team will collect student feedback on high-interest topics and use this feedback to develop initial datasets and resources that serve as core elements of RWDS project modules.

Each project will follow the data science process proposed in the GAISE II report. Students will formulate research questions for the project, collect data relevant to their research questions, conduct data analysis, and use these analyses to answer their research questions. Projects may require students to develop and suggest a solution to a community or industry challenge, increase awareness about a regional problem, or use their analysis to share new and unique perspectives on an issue.

For each project, students will engage in an authentic exhibition of their work by presenting and publishing work for teachers, community members, families, industry partners, and peers. To ensure each project's authenticity, students will exhibit and publish their work beyond their school. For community or industry challenge-focused projects, the exhibition of projects will include students pitching their solutions to industry or community decision-makers and advocates. Additionally, students will publish their data visualizations and other deliverables generated for projects on social media and disseminated through community networks and partnerships.

Design Element 3: Ongoing interaction with industry professionals: Industry volunteers will connect with students at several key points during each project module offered during the RWDS

course. First, industry and community volunteers will help introduce a new project to students in a course. During these introductions, volunteers will interact with students to introduce the project's focus, provide context about the issue, and describe any specific challenges or issues they are trying to solve. For example, a city planner may visit a class to introduce a project about how to increase green space within the city.

Once students begin working on RWDS projects, they will connect with subject matter experts who can help them better understand the context and content related to the project. For example, as students begin working on a project about increasing green space in Kansas City, they may connect with a botanist or environmental scientist to better understand the impact of green space on air quality data. Additionally, students will connect with data science professionals to better understand and apply data science projects to each project.

Industry volunteers will also play a vital role in each project's exhibition, publication, and assessment. As part of the culmination of each project, students will present their findings to their teachers, peers, and volunteers from Kansas City businesses and community organizations. Additionally, students will connect with businesses and community organizations to publish and disseminate their work beyond the school building.

Industry volunteers will also work with teachers to provide feedback on student work. This feedback will include assessments and feedback on students' data literacy and data science skills as well as on critical affective skills such as collaboration, problem-solving, project management, and communication. Finally, students will engage in guided reflection with adults and volunteers to process how various RWDS projects influence their high school, college, and career plans.

PREP-KC has developed a network of over 225 business and community partners that have helped us recruit over 1,400 industry volunteers. Several of these industry partners have provided us

with letters of support committing volunteers to the RWDS program, and we have included these letters in Appendix C of this application. We will draw on these partnerships to recruit the approximately one hundred volunteers needed to connect students with STEM professionals in RWDS classrooms across our network.

Design Element 4: Supporting participating teachers through a cross-sector professional learning community: PREP-KC will collaborate with school districts participating in the RWDS study to identify middle school faculty to teach the RWDS course. Each participating school will identify one faculty member to teach the course. RWDS teachers may have mathematics, science, or technology backgrounds. In some cases, teachers may have other expertise or experiences that make them appropriate instructors for the RWDS course.

Successful implementation of the RWDS course will require teachers to master new content and learn or refine the foundational pedagogy that drives the program. PREP-KC will provide this support to teachers through a data science professional learning community (DSPLC) for RWDS teachers. The DSPLC will be a comprehensive, cross-sector opportunity that brings teachers together with data science professionals, higher education faculty, and staff from PREP-KC's Teaching & Learning team. Through the DSPLC, RWDS will engage in at least 40 hours of pre-service training each summer and 52 hours of in-service training each year. The DSPLC will also provide teachers peer coaching, best practices sharing, and a support network as they engage in personalized, asynchronous professional learning focused on data science tools such as Tableau. Through the training offered by the DSPLC, all RWDS teachers will earn Tableau certification and Data Science Trainer credentials offered through the National Career Certification Center (NC3) and can pursue other micro-credentials.

In addition to supporting teachers through the DSPLC, PREP-KC will deploy two data science coaches to provide job-embedded coaching to teachers throughout the year. Coaches will engage in instructional coaching cycles with teachers throughout the school year and provide co-planning, modeling, and co-teaching support. Additionally, they will provide teachers with ongoing opportunities for guided reflection and feedback on growing their data science content knowledge and consistently integrating PBL and CRST practices into the RWDS classroom.

B.2 Project Design- Program goals, objectives, and outcomes: PREP-KC has two goals for the RWDS: 1) increase students' math and science outcomes for high-needs students and 2) increase high-needs students' participation in high school STEM pathways. To achieve these goals, the RWDS team has developed the following objectives and measures and aligned these with key program activities:

<table>
<tr><th colspan="3">Objective 1: Increase students' data literacy and mastery of the data science process</th></tr>
<tr><th>Measure</th><th>Data Source</th><th>Aligned Program Activities</th></tr>
<tr><td>1.1 Students' data literacy levels</td><td>• Levels of Conceptual Understanding in Statistics (LOCUS) assessments</td><td rowspan="2">• Develop and implement the RWDS curriculum
• Design and implement student projects</td></tr>
<tr><td>1.2 Student understanding of the data science process</td><td>• Tableau Certification Exam</td></tr>
<tr><th colspan="3">Objective 2: Develop students' ability to transfer data science skills to improve math and science outcomes</th></tr>
<tr><th>Measure</th><th>Data Source</th><th>Aligned Program Activities</th></tr>
<tr><td>2.1 Algebra I proficiency</td><td>• Algebra I grade
• Algebra I State Assessment</td><td rowspan="2">• Develop & implement RWDS curriculum
• Design & implement student projects</td></tr>
<tr><td>2.2 Biology proficiency</td><td>• Biology I grade
• Biology I State Assessment</td></tr>
<tr><th colspan="3">Objective 3: Increase students' awareness and enthusiasm for STEM Pathways.</th></tr>
<tr><th>Measure</th><th>Data Source</th><th>Aligned Program Activities</th></tr>
<tr><td>3.1 Students' awareness of STEM career pathways</td><td>• Career Interest Survey</td><td rowspan="2">• Design and implement student projects
• Engage students through ongoing interactions with industry professionals.
• Engage in self-reflection during the feedback and reflection process</td></tr>
<tr><td>3.2 Student Interest in STEM-focused pathways</td><td>• Career Interest Survey
• HS Course/Pathway Selection
• Individual Graduation Plans</td></tr>
</table>

Objective 4: Develop teachers' data science knowledge and proficiency in PBL and CRST.		
Measure	**Data Source**	**Aligned Program Activities**
4.1 Teachers Data Science Content Knowledge	• NC3 Data Analytics Certification • Tableau Certification Exam	• Pre- and in-service professional development for RWDS teachers • Provide ongoing coaching during school year • Convene RWDS DSPLC • Engage in CIC cycles
4.2 Teachers develop capacity for PBL		
4.3 Teachers develop capacity for CRST	• PBL Training Records • DSPLC Artifacts • CIC classroom observations • Teacher surveys • Student surveys	

The RWDS team will employ a continuous improvement framework to gauge progress towards these goals and refine and adapt implementation strategies based on formative data. We will employ a Continuous Improvement Coach (CIC) to support this process. The CIC will work with the project evaluators to lead formative data collection efforts, including learning walks and classroom observations. The CIC will also gather formative feedback and observe the fidelity of implementation. The CIC will participate in monthly RWDS project meetings and check-ins with the evaluation team to provide ongoing insights from formative evaluation and produce two formal memos in the fall and at the end of each implementation year summarizing formative evaluation data and recommendations.

B.3 Project Design- Addressing the Needs of Target Populations: We define "high needs" students as those who identify as BIPOC or students growing up in low-income households. Over 80% of the students enrolled in PREP-KC's partner school districts identify as BIPOC, and over 80% qualify for free or reduced lunch programs due to low household income. PREP-KC explicitly designed RWDS to address two inequities that impact high-needs students:

Inequity 1: Achievement in Math and Science: Researchers have extensively documented the academic gaps between high-needs students and their counterparts (Duncan and Murnane, 2011; Reardon, 2013; Hansen et al., 2018). These academic gaps, especially in math and science, are a

critical factor in the underrepresentation of BIPOC and low-income students in STEM workforce pipelines (Jones et al, 2018). Algebra I serves as a "gatekeeper" course for many BIPOC students, and an unsuccessful Algebra I experience can keep students from pursuing further rigorous STEM opportunities in high school (Loveless, 2013).

RWDS provides students with additional, explicit instruction that develops students' conceptual and applied understanding of essential math and science standards. This additional 65-80 hours of instruction, *in addition to* existing math and science coursework, can help boost student achievement in math and science. Specifically, RWDS addresses the data analytics, modeling, and visualization skills included in the Next Generation Science Standards (2013). Additionally, RWDS provides students with a deeper exploration of several critical math standards needed during the transition to higher mathematics, including understanding and developing algorithms, developing linear equations, and applying statistical frameworks.

Inequity 2: Participation in STEM Pathways: High-needs students are less likely to engage in early STEM interactions and experiences that encourage the development of STEM identity and the pursuit of STEM pathways in high school and beyond (Bluestein et al., 2013). As underrepresented students enter high school, they are less likely to sign up for CS and other STEM courses (Code.org et al, 2020). Additionally, BIPOC students prioritize giving back to their communities more than their White peers (Garibay, 2015) yet many do not view STEM as a career path through which they can do this (Jidesjö et al., 2009; Potvin & Hasni, 2014).

Through its focus on high-interest, culturally responsive projects as the foundation of the student experience, RWDS provides high-needs students with both meaningful first-hand experience in STEM and an excellent on-ramp to STEM pathways in high school and beyond. Students will connect their values and interests to STEM pathways throughout the course. Industry volunteers will

also help students better understand how various STEM-focused pathways provide opportunities for students to help others in their community, address inequalities, and bring about change in Kansas City and across the globe.

C. Project Personnel: PREP-KC will deploy a diverse, experienced team to manage, implement, and evaluate the RWDS initiative. Five of the eight members of our project team are female (63%), and three members (38%) belong to other traditionally underrepresented groups. PREP-KC will seek to further diversify the composition of our project team when hiring the two data coaches and the continuous improvement coach during the project's first year.

PREP-KC's Vice President will serve as **project director (PD).** The PD will also serve as the primary liaison with MDRC, the evaluator for this project. Our Director of Teaching & Learning will serve as the **Design Team Lead (DTL)**. The DTL will co-direct the **Data Science Professional Learning Community** along with our **School Design Specialist (SDS)** and **Lead Curriculum Designer (LCD).** The following table summarizes team members' roles and backgrounds, with abbreviations in parentheses corresponding to roles on the management plan:

Name/Title	RWDS Role/Responsibilities	Experience and Background
[redacted] President & CEO-**(PR)**	• Oversees project design, implementation, and evaluation • Secure and allocate necessary resources for project success • Ensure PREP-KC uses EIR funds in allowable/appropriate ways and meets reporting requirements • Accountable for financial aspects of the EIR project	• 16 years of experience as founder of PREP-KC. • Manages partnerships with ten school districts, 30+ funders, and over 225 businesses Serves as co-chair of Workplace-Based Learning Committee for KS Governor's Council for Education.
[redacted] Ph.D., Vice President-**RWDS Project Director (PD)**	• Serve as RWDS **Project Director (PD)** • Oversee implementation of the project • Manages operational plans • Monitors implementation • Primary liaison with school districts • Lead monthly project meetings	• Leads programming across PREP-KC's 62 school partners since 2016. • Led implementation of Diplomas Now (DN) i3 at Johns Hopkins University • Ph.D. in Education Policy, M.Ed. in Education Leadership from the University of Kansas

Name/Title	RWDS Role/Responsibilities	Experience and Background
[redacted] Dir. of Teaching & Learning **Design Team Lead (DTL) and co-director of (DSPLC)**	• Leads RWDS design team **(DTL)** • Leads implementation of RWDS program components • Co-directs DSPLC • Supervises Data Science Coaches	• Leads PREP-KC's academic initiatives, including K-3 literacy and K-12 mathematics work • Served as middle school assistant principal, instructional coach, and math teacher • B.S. in computer science and M.Ed. in Educational Leadership • Former computer programmer
[redacted] School Design Specialist **(SDS)**	• Co-directs DSPLC • Member of the curriculum design team with an emphasis on standards alignment • Supports schools with scheduling and student assignment logistics	• Certified master facilitator by National School Reform Faculty • Former director of high schools, career and technical education director in the large urban school district • M.Ed. in Special Education
[redacted] Pathways to Technology Facilitator **and Chief Curriculum Designer (LCD)**	• Co-facilitates DSPLC • Co-developer of RWDS curriculum • Emphasis on project design and implementation • Provides expertise in Tableau, Excel, and other RWDS technology tools	• Designed CS curriculum including data science, HTML, Python, and Java • Supervises student internships and client-connected projects • B.S. in Mathematics, completing master's degree in Computer Science
[redacted] Dir. of Community & Industry Partnerships **(DCI)**	• Leads recruitment of industry and community partners • Supports student project design & implementation	• Manages partnerships with over 225 business & community organizations • Experience designing and industry-focused "client projects."
Two Data Sciences Coaches **(DSC)**	• Provides ongoing data science coaching to RWDS teachers	• To be hired
Continuous Improvement Coach **(CIC)**	• Collect formative evaluation data • Compiles formative evaluation memos	• To be hired
[redacted] Evaluation Director & Impact Lead, MDRC **(ED)**	• Oversees research activities and overall project management. • Leads meetings with PREP-KC on planning, formative, and summative work. • Leads data analysis/impact work for summative phase of evaluation. • Leads dissemination of evaluation findings with PREP-KC and partners.	• Served as project manager on impact and implementation leadership teams for the evaluations of CIS, NYC Small Schools of Choice, and City Year. • Led quantitative and qualitative data collection and analysis on multiple MDRC projects. • Ed.M. in Education Policy & Management from Harvard GSE.

Name/Title	RWDS Role/Responsibilities	Experience and Background
[redacted] Evaluation Implementation Lead, MDRC **(EID)**	• Collaborates with CIC and PREP-KC to develop instruments, fidelity measures and data collection during formative phase. • Leads implementation study, site visits, and qualitative data collection activities and analysis.	• Leads the Next Generation California Partnership Academies Study; led the i3 impact study of Diplomas Now and REL Northwest evaluation of early warning indicator systems in Oregon. • Manages implementation data on multiple evaluations; has depth of experience in designing surveys and interview protocols; designed fidelity matrices for AVID and D i3 evaluations. • MPP in Public Policy from U. of Chicago.

D. Project Management Plan: PREP-KC's management plan for RWDS includes clearly defined timelines, activities, and responsibilities. The following charts provide a comprehensive overview of significant milestones, timelines, and activities for the RWDS project:

Project Management	**Year 1**				**Year 2**				**Year 3**				**Year 4**				**Year 5**			
Action Item (Team Lead—see abbreviations in project personnel table)	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F
Refine project plan with DOE (PD)	X																			
Confirm roles and responsibilities (PD)	X																			
Hire Data Science and CI Coaches (DTL)	X	X																		
Develop annual operations plan (PD)		X				X				X				X						
Develop project tracking system (PD)		X																		
Evaluate progress & add goals (PD)			X		X		X		X		X		X		X		X		X	
Submit annual reports to DOE (PR)				X				X				X				X				
Hold monthly team meetings (PD)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Planning & Design	**Year 1**				**Year 2**				**Year 3**				**Year 4**				**Year 5**			
Action Item	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F
Design course modules (LCD)	X	X																		
Design project modules (LCD)	X	X																		
Secure partner contracts (PD)	X	X																		
Develop project calendar (DTL)	X	X				X				X				X						
Identify RWDS teachers (DTL)	X	X																		
Build schedules/assign students to RWDS course (SDS)		X				X				X				X						
Data Science content PD (DTL)		X	X																	
PBL training for teachers (DTL)		X	X				X				X									

Planning & Design	Year 1				Year 2				Year 3				Year 4				Year 5			
CRST training for teachers (DTL)		X	X				X				X									
Recruit volunteers (DCI)		X		X		X		X		X		X		X						
Collect student feedback to determine project topics (LCD)	X	X		X		X		X		X		X		X						
Host RWDS Launch Institute (DTL)			X																	

Project Implementation	Year 1				Year 2				Year 3				Year 4				Year 5			
Action Item	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F
Use student feedback to refine projects (LCD)	X	X			X	X														
Cohort 1 enrolls in RWDS course (PD)			X	X	X	X														
Cohort 2 enrolls in RWDS course (PD)							X	X	X	X										
Cohort 3 enrolls in RWDS course (PD)											X	X	X	X						
Provide Teacher Coaching (DSC)			X	X	X	X	X	X	X	X	X	X	X	X	X					
Hold DSPLC meetings every 6 weeks (DTL)		X	X	X	X	X	X	X	X	X	X	X	X	X	X					
Conduct CIC Cycles (CIC)		X	X	X	X	X	X	X	X	X	X	X	X	X	X					
Publish CIC Memos (CIC)				X		X		X		X		X		X		X				
Adjust implementation based on formative feedback (DTL)				X	X	X	X	X	X	X	X	X	X	X	X	X				
Project Evaluation	**Year 1**				**Year 2**				**Year 3**				**Year 4**				**Year 5**			
Action Item	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F
Secure IRB approval for study (ED)	X	X																		
Develop CIC tools (EID)		X	X																	
Collect baseline data for cohort 1 (ED)		X																		
Collect baseline data for cohort 2 (ED)						X														
Monthly CIC meetings (ED)			X	X	X	X	X	X	X	X										
Establish fidelity indicators & thresholds (EID)	X	X																		
Collect data for cohort 1 (ED)			X	X	X	X	X	X	X	X	X	X	X							
Collect data for cohort 2 (ED)							X	X	X	X	X	X	X	X	X	X	X			
Summative Analysis (ED)																		X	X	
Publication and Dissemination (ED)																		X	X	X

E. PROJECT EVALUATION

Overview of Evaluation Design and Research Questions: MDRC, a leading third-party evaluator, will conduct an independent evaluation of PREP-KC's RWDS 8th grade course and its effects on students' short-term and intermediate outcomes using a student-level randomized control trial. We will include a formative phase to the evaluation that will inform and improve course design, teacher

training and coaching, and instructional practice. Additionally, a summative phase of the evaluation will evaluate whether the intervention has the potential to improve students' outcomes in STEM-related academic courses (Algebra I and Biology I) and their likelihood of pursuing STEM-focused high school courses.

Formative Phase (January 2023-July 2024): PREP-KC will develop and refine the course materials, teacher training, and coaching during the planning year and pilot these components during the first year of implementation (SY 23-24). The Continuous Improvement Coach (CIC) will lead the formative phase work and plan data collection activities, with support from the MDRC research team for developing instruments and conducting analysis. During this phase, the CIC will collect formative data about the program's usability, feasibility, and fidelity. Formative data sources for teacher professional development and instructional practice will include learning walks, training observations, interviews with staff delivering and taking the training, and end-of-training surveys. During SY 23-24, students will complete a baseline and end-of-course survey, which will help inform any changes needed to the course for SY24-25 based on student experiences. MDRC and the CIC will share findings from the formative work with PREP-KC on an ongoing basis through monthly phone calls. They will provide more formal formative feedback through memos for PREP-KC at two points: at the end of fall and the end of spring semesters of SY23-24. The fall memo will reflect on the pre-implementation preparation of teachers to teach the course; and will share feedback about early implementation, specifically on teacher practice and coaching and training provided to them in the fall. The spring memo will share additional feedback on teacher practice, ongoing professional support, and student survey results about students' experiences.

Summative Phase (SY2023-24 & SY2024-25): The two-year summative phase will evaluate the implementation of the RWDS course and associated teacher training/coaching and the impact on

student outcomes using a student-level RCT. The impact study will follow two cohorts of students in PREP-KC partner schools. The study will randomly assign students to enroll in the 8th grade RWDS course or take other typically offered electives, with a focus on their short-term (data literacy, awareness of STEM professions) and intermediate outcomes (performance in STEM courses, selection of STEM-focused high school courses and pathways), as referenced in the logic model. We will evaluate the program's effect on these students' outcomes by comparing the average outcomes of the two groups of students. Table 1 below lists the study's research questions.

The implementation study will assess how well the course implementation and teacher support compare to expectations based on the program design. To assess the fidelity of implementation, MDRC will draw upon the data collection activities during the formative phase conducted by the CIC and new data collection activities led by the MDRC research team. MDRC will collect data from PREP-KC's program records (via their own Management Info System), teacher and student surveys (pre and post), the CIC's observations of classroom instruction and teacher professional development activities, and group and individual interviews conducted with students and teachers by the CIC (SY23-24) and by the CIC and MDRC (SY24-25).

Dissemination: MDRC and PREP-KC will disseminate summative findings to practitioners and policymakers in a publicly available report, conference presentations, and a two-page brief. The brief will be an easily digested two-page summary of highlights and key findings from the report and their practical implications. To supplement this short deliverable, MDRC will conduct webinars with PREP-KC and its local district and industry partners to share and discuss findings.

Table 1: Confirmatory, Exploratory, and Implementation Research Questions

Research Questions	Outcomes/Measures	Data Sources
Intermediate Impacts (confirmatory)		
What is the effect of the RWDS 8th-grade course on math outcomes?	•Algebra I course grade • Algebra I State Assessment	•School Records

What is the effect of the RWDS 8th-grade course on students' science outcomes?	•Biology I course grade •Biology I State Assessment	•School Records
Is there an increase in students selecting STEM-focused high school course of study?	•HS Course/Pathway Selection	•School Records
Short-term Outcomes (exploratory)		
What is the effect of the RWDS course on data literacy and mastery of the data science process for students?	•Score on the LOCUS assessments [1]	• Levels of Conceptual Understanding in Statistics (LOCUS) assessments
Does the RWDS course increase awareness and exploration of STEM professions for students?	•% of program students who intend to pursue STEM courses in HS. •% of students who intend to pursue employment in STEM fields.	• End-of-year student survey[2]
Do teachers display an increased mastery of data science and project-based learning?	•% of teachers reporting improvement in their understanding and teaching of data science and PBL. • Teachers' scores on Tableau Certification Exam	• End of year teacher survey and observations • Tableau Certification Exam
Implementation		
Were the components of the RWDS teacher P.D. implemented with fidelity?	•Fidelity indicators (with thresholds) for each core teacher PD training activity	PREP-KC program records, teacher surveys, and student surveys.
Was the RWDS course/classroom instruction implemented with fidelity?		

1 A pilot study of LOCUS noted "reliability (as measured by stratified α) was between 0.70 and 0.72 for the four Beginning/Intermediate levels and was 0.87 for the four Intermediate/Advanced levels" (Whitaker et. al, 2015).

2 MDRC will draw on scales from previously validated instruments, including those used in its studies of Communities In Schools integrated student supports (Parisi et al, 2017) and CTE Advising study (Rosen and Garcia, 2020). These survey measures are expected to meet WWC standards for the reliability of outcome measures, with values exceeding Cronbach's alpha of 0.5 (ranging from .81-.89) and the research team also will assess the construct validity and reliability of survey measures within the evaluation's analytic sample.

What were the drivers of fidelity?	•Facilitators to implementation •Barriers to implementation •Adaptations to the program	Annual observation of teacher training, teacher interviews, and student surveys.

E.1 The Evaluation Will Meet What Works Clearinghouse Standards Study design and Student Sample: MDRC will assess the effect of RWDS using a student-level RCT in ten study schools located across 4-5 school districts in Kansas City Metropolitan area. In Summer 2023, incoming 8th-grade students in the study schools will be entered into a lottery for the PREP-KC data science course (unless they opt out). Through the lottery, we will randomly assign students to receive either the course (program group) or not receive the course and continue with their other "business-as-usual" course offerings (control group). The evaluation will follow these students to the end of ninth grade (SY24-25). We will randomize the second cohort of 8th-grade students in Spring 2024 and follow them through the end of their 9th-grade year (SY25-26). The confirmatory analysis sample will be the second cohort since PREP-KC will expose these students to a program that incorporates feedback from the formative phase and that the project team has more fully developed. This version of the program, therefore, better represents the version of the program PREP-KC will scale up. As an exploratory analysis, the evaluation will also assess the program effects on the first cohort of students, the differential and pooled effects across the two cohorts, and the effects on subgroups of students that are of interest to policymakers, such as students from disadvantaged backgrounds. The study will meet WWC standards without reservations.

Baseline Equivalence: The study's random assignment design should result in baseline equivalence of the program and control groups, which we will verify using SY22-23 school record data. The evaluation team will assess baseline equivalence on student characteristics such as race/ethnicity and sex, as well as at least one measure of the degree of disadvantage (e.g., poverty status), involvement

in school support programs (e.g., multilingual programs and Special Education), and available measures of their grade seven academic performance, including math and science.

Attrition: MDRC will evaluate the impact of program courses on students in the study sample for whom outcomes data are available. The team expects low overall and differential attrition between the treatment and control groups. First, outcomes for the impact study will come from school records, so student mobility will primarily drive attrition rather than non-consent or non-response. Given PREP-KC's partnership and data sharing agreements with multiple districts in the KC metro region beyond just the study districts, the study team expects to be able to track students whose mobility is regional. A conservative expectation of the overall attrition rate is around 20-25% based on other MDRC studies of a similar student population. Second, it is unlikely that the program (an elective course in 8th grade) will affect students' mobility one year later. Therefore, the team expects the mobility pattern to be similar across program and control students. In addition, the study will not include students in the sample who join the RWDS course after random assignment. Regardless, the evaluation team will assess and report the differential attrition rate between the two groups of students and compare baseline characteristics between students who remained in the sample and those who dropped out.

Minimum Detectable Effect Size (MDES): Given expected attrition rates, approximately 1,500 students (10 schools; 150 students in each 8th grade per school) will be included in the confirmatory impact analysis (cohort 2), split equally between the program and control group. The MDES for this confirmatory estimation is MDES=0.11. The study will be able to detect an effect of about 1.4 scaled score point change on ninth-grade Algebra I test scores, about 3.6 percentage point change in the proportion of students who scored at or above proficiency level in the same test. Additionally, the study will be able to detect about 1.7 scaled score point change in ninth-grade Biology test scores or

about 5.5 scaled score point on 8th-grade math test scores. This effect size is equivalent to about 50% of the annual gain in Math for ninth graders (Table 3, Bloom et al., 2008), which are "substantively meaningful" effect sizes as viewed by the WWC[3]. We base the MDES on 80% power, an alpha of 0.05, and an R-squared value (variance explained by the baseline covariates) of 0.4, based on existing evidence (see Bloom et al., 2005; Hedges and Hedberg, 2013). The minimum detectable effect size for the exploratory analysis pooling the two cohorts of students will be 0.08.

Valid and Reliable Outcomes: The confirmatory outcomes for the evaluation are Algebra I grades and test scores, Biology I grades and test scores, and high school course/pathway selection. These outcomes have face validity and reliability, and we will collect them at the same time and manner for both the treatment and control groups.

Impact Analysis: The analysis will provide the impact estimate of offering the RWDS course (intent-to-treat). Due to student interest in data science and the opt-out nature of the RWDS course, we expect the take-up rate of the RWDS course to be high. However, we still plan to look at the program impacts on those who complete the year-long course through a treatment-on-treated analysis to gauge the maximum potential effect of the program. We will estimate impacts on the study's main outcomes based on all treatment and control students randomized at the start of their 8th grade. The basic impact estimate will be from a regression model where the dependent variable is student outcome. The model will account for the blocked random assignment design (blocked within school-by-cohort cells). To improve the precision of impact estimates, the model will control for a variety of

[3] Based on the meta-analysis provided by Deke et al (2022), which used all high school studies from the WWC evidence database that reported impacts on students' math achievement to generate an impact distribution, the likelihood of finding an impact estimate of at least 0.10 standard deviations in effect size is 57%, and the likelihood of finding one that is at least 0.15 standard deviations in effect size is 47%.

student baseline characteristics obtained from SY22-23 school records, including age, gender, race/ethnicity, poverty status, English language learner status, special education status, and academic performance. Though we expect low missing rates for these covariates since they will come from administrative data, we plan to use the "dummy-variable" imputation approach to handle the missing covariate value issue (Puma et al, 2009). The confirmatory analyses cover three outcomes domains: Algebra I, Biology I, and High School STEM course-taking pattern (See Table 1). If the analysis presents multiple outcome measures in a given domain, we will use the Benjamini-Hochberg (1995) procedure to correct for multiple hypothesis testing.

Moderators: The study will explore whether program courses' effects differ by gender and race/ethnicity, prior academic performance on STEM state assessments, and baseline student attitudes about STEM courses and professions.

Mediators: MDRC will conduct an exploratory analysis using the instrumental variables (IV) approach, which leverages the RCT design to examine the association between certain mediators and student outcomes (Imbens and Angrist (1994) Angrist et al. (1996). Two potential mediators of interest are (1) dosage: number of hours of interaction with data science professionals and (2) data science mastery: student score on the LOCUS assessment.

Components and fidelity thresholds: The logic model outlines the planned components of the project interventions. We will use the formative phase to refine the logic model and inform the development of a framework for measuring fidelity. This framework, developed in collaboration with PREP-KC, will include indicators that measure adherence to activities in the logic model and a priori benchmarks for acceptable implementation overall, as well as for each component. The evaluation team will then use the framework to measure fidelity during the summative phase, using program records, and teacher and student surveys.

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