

STEM Teacher Leadership Framework



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Section 1:

STEM Teacher Leadership Framework

1.1 Why STEM Teacher Leadership

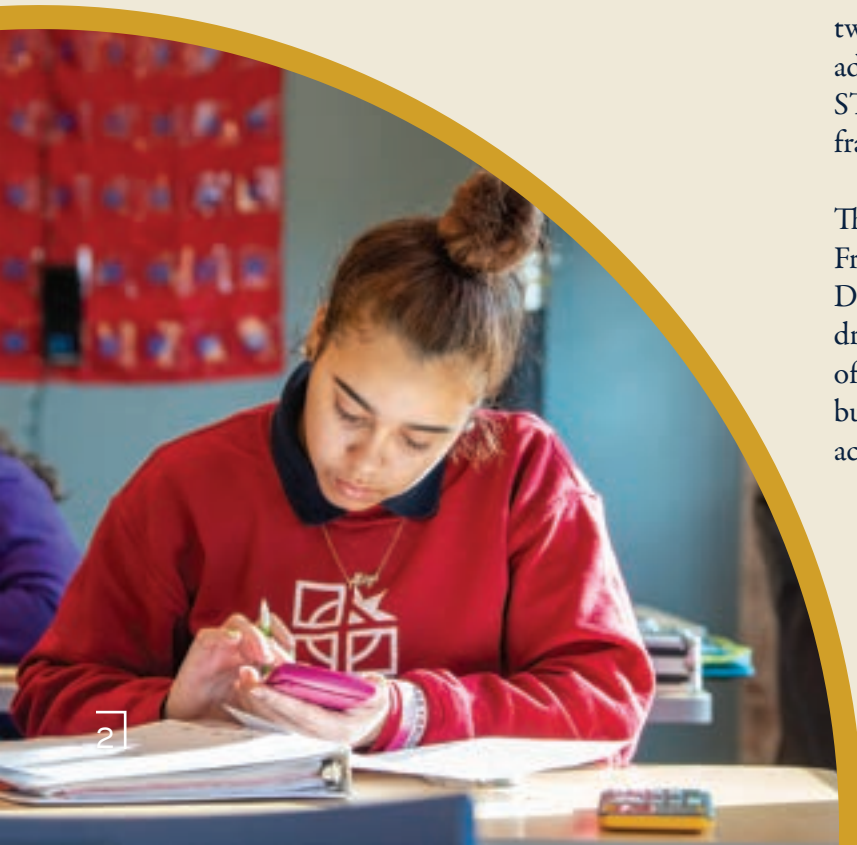
Teachers change lives.

Not through magic or innate skill, but through high-quality interactions with young people that position them as thinkers and doers. These pedagogical and relationship-building skills can develop over time, resulting in what research has shown to be the greatest impact on students within the control of educational institutions. The excellence of teachers can be transformative beyond a single classroom, presenting an opportunity for administrators to distribute leadership responsibilities and to position teachers as agents of change in ways that promote the on-going growth of their peers and the entire school community.

We believe that the most effective schools empower all members of the community to contribute to the vitality of the institution. Teacher leadership is a critical dimension of this culture, wherein teachers provide support for colleagues, administration, and students. This form of collective leadership generates a network among and between members of a school community who share student learning and formation as a common goal.

While much of this framework speaks to the formation of teacher leaders broadly, we recognize particular aspects important for the development of **STEM** Teacher Leaders. The framework recognizes the existence of varied conceptions of STEM education including both individual disciplinary experiences (science, technology, engineering, and mathematics) and STEM integration, in which two or more of the disciplines are drawn upon to address real world problems. Both conceptions of STEM education are addressed throughout this framework, as applicable.

This STEM Teacher Leadership Framework (the Framework) was designed specifically for the Notre Dame STEM Teaching Fellowship; however, drawing on contemporary research and the wisdom of practice, we believe it has broad applicability for building the capacity of STEM teacher leadership across programs, schools, and the field.



1.2 A Framework for STEM Teacher Leadership

A STEM Teacher Leader promotes a high-quality STEM learning experience for all students. To ensure access and opportunity, particularly for those who might be most marginalized and vulnerable, STEM Teacher Leaders approach their work with particular **dispositions** – qualities of mind and character, **knowledge** – ideas and concepts, and **practices** – ways of implementing the work of teaching. The STEM Teacher Leader's influence creates a radius of change from the **personal** sphere of their classroom, to the **interpersonal** interactions with members of the school community, to the **institutional** policies and practices of the school, and more broadly into **systems** embedded within their communities and beyond.



1.3 A Focus on Human Flourishing

Collective Language

STEM education, like all teaching, is not a neutral act. The wide range of choices that teachers make every day not only impacts the disciplinary learning of students but also their beliefs, actions, and future trajectories. The way in which teachers interact with members of their school communities not only impacts the day-to-day operations of the school, but also how colleagues and school families feel seen, heard, respected, and empowered as partners in the education of young people.

This STEM Teacher Leadership Framework is oriented toward promoting the full human flourishing for all members of our school communities, ensuring that each person has access to what they need to thrive.

We believe that STEM Teacher Leaders promote human flourishing not only in their classrooms, but across the different contexts within their personal and professional lives:

PERSONAL

One's own beliefs and behaviors

INTERPERSONAL

One's interactions with students and colleagues

INSTITUTIONAL

One's school or organization's policies and structures

SYSTEMIC

The culture and norms built into society



An Action-Oriented Approach

A focus on human flourishing is central to the dispositions, knowledge, and practices in our Framework. We draw on four foundational tenets – tenets drawn from Catholic Social Teaching and applicable in both religious and secular settings – that provide an action-oriented and person-centered approach to promoting justice.

Although drawn from the Catholic religious tradition, Catholic Social Teaching is addressed to all people of good will – to all who desire a world characterized by greater unity and justice, and grounded in love. It expresses a perspective that recognizes the solemn, inherent dignity of every person and values their capacity for human flourishing as members of community,

interdependent and bound together in mutual care. The two tenets of elevating the dignity of the individual and promoting the common good, therefore, are the primary principles from which all other commitments and actions flow.

Collectively, these four tenets provide a set of principles that can help guide the words, beliefs, and actions of STEM Teacher Leaders towards cultivating a thriving school community. We believe that it is essential for these principles to be deeply woven and integrated into the fabric of teacher leadership, and as such, these positions are seamlessly embedded throughout each of the domains and descriptions of the Framework.



FOUNDATIONAL TENETS



Elevating the Dignity of the Individual

The dignity of the individual is foundational to all human interactions and sets the stage for a transformative approach to teaching, learning, and leadership. At its root, this tenet claims that every person has inherent and immeasurable worth. Each person is unique and beloved for who they are, not based on what they can do or accomplish. Human dignity does not need to be earned and it cannot be stripped away, although it can fail to be recognized. Honoring students as they are and valuing all colleagues are just two ways of elevating the human dignity of others.



Promoting the Common Good

Full human flourishing is realized within the context of community. Communities animated by the common good are organized so that all members are able to fully participate in the community's shared life. Promoting the common good entails a sense of solidarity, an understanding that each person's good is bound up with the well-being of others. It holds paramount the sentiment that "no one wins unless everyone wins." It may take many forms as students, teachers, and administrators work toward common goals, including inviting diverse opinions and celebrating the value of each member of the community.



Empowering the Marginalized & Vulnerable

Those who are vulnerable or on the margins can often be excluded from fully participating in the life of the community. Working towards the human flourishing of the marginalized and vulnerable ensures justice, access, and opportunity for all people, particularly those who are disenfranchised. School settings include vulnerable populations in both obvious and imperceptible ways. Educators are called to recognize and act upon the needs of the individuals in their school communities with an intentional eye toward elevating and empowering those with the greatest needs.



Acting with Rights & Responsibilities

Human dignity bestows each person with certain fundamental rights that must be respected. As members of a community, each person is also entrusted with the responsibility to contribute to the common good. All are called to work together, each with corresponding rights and responsibilities, to create a thriving community. For example, educators have the right to exercise their voice in collective decision-making within a school setting, as well as the responsibility to listen to the voices of other members of the community who may not be heard.



1.4 STEM Teacher Leadership Dispositions

An essential component to being an effective and transformational STEM Teacher Leader is developing and enacting helpful dispositions that shape the manner in which the STEM Teacher Leader approaches their work and carries themselves when interacting with colleagues. These dispositions are founded on the two foundational tenets of elevating the dignity of each individual and the responsibility to promote the common good within school communities. This list is not exhaustive, but we believe that these dispositions are particularly important for strong leadership in STEM education:

CONFIDENT

Secure in one's abilities without being arrogant; decisive

COURAGEOUS

Willing to take risks and embrace challenging opportunities

EMPATHETIC

Recognizes and validates the experiences of others

FLEXIBLE

Adjusts easily to changing situations and conditions

HUMBLE

Seeks to serve others without attention to one's self

OPTIMISTIC

Filled with hope, joy, and enthusiasm

RECEPTIVE

Open to feedback, discomfort, and coaching

TENACIOUS

Determined persistence despite obstacles

1.5 STEM Teacher Leadership Domains of Knowledge and Practice

Domain 1: Advancing Personal Expertise in Teaching

A STEM Teacher Leader enacts and models high-quality STEM teaching within their own discipline. Drawing on research and the wisdom of practice, the STEM Teacher Leader ensures that all students have opportunities for high-quality STEM learning experiences.

The STEM Teacher Leader...

1.1 Continually increases STEM disciplinary content knowledge.¹

1.2 Designs, adapts, or uses STEM curricular elements that engage students in using disciplinary content and practices.²

1.3 Positions students to approach and address meaningful and/or authentic problems that integrate multiple disciplines.³

1.4 Uses cognitively-supportive and student-centered pedagogical practices that connect a disciplinary focus with theories of learning, especially those that center student voice and experience.⁴

1.5 Gathers evidence of student thinking and uses it to provide feedback to learners and to adapt future instruction.⁵

1.6 Interrogates personal beliefs about students, teaching, and leadership.⁶

Domain 2: Advancing STEM Teaching Practice Among Colleagues

A STEM Teacher Leader provides support for continuous improvement related to high-quality STEM curriculum, instruction, and assessment. By engaging peers and other professional members of the school community, the STEM Teacher Leader works to increase STEM teaching capacity in a range of specific contexts.

The STEM Teacher Leader...

2.1 Supports and helps create a culture of professional growth amongst colleagues.⁷

2.2 Understands adult dispositions and ways of learning to improve STEM teaching quality.⁸

2.3 Provides high-quality mentoring and/or coaching for colleagues that attends to contemporary views of high-quality STEM teaching and learning.⁹

2.4 Accesses and shares contemporary educational research with the school community.¹⁰

2.5 Facilitates professional growth for members of the school community by leading structured professional learning experiences that encourage reflection, inquiry, and growth.¹¹

Domain 3: Advancing Institutional STEM Approaches

A STEM Teacher Leader helps create a shared vision for STEM at their school. By working with a variety of stakeholders, the STEM Teacher Leader helps develop a collective understanding of STEM, long-term goals, and policies and practices for STEM education that foster multiple pathways for participation and engagement by members of the local community.

The STEM Teacher Leader...

3.1 Identifies assets and barriers to high-quality STEM learning within their school community.¹²

3.2 Enacts processes to build consensus that honor the voices of all stakeholders.¹³

3.3 Works with the community to develop an actionable, strategic plan for STEM education with achievable and measurable goals.¹⁴

3.4 Draws on various data to iteratively refine strategic planning and to inform decision-making for continuous improvement.¹⁵

3.5 Maintains documentation of initiatives and delivers effective and consistent messaging about these initiatives to different audiences.¹⁶

3.6 Creates capacity for sustainable funding to support the school's STEM goals.¹⁷

Domain 4: Advancing the Field of STEM Education

A STEM Teacher Leader engages in and contributes to the national conversation around STEM education and access to high-quality education more broadly. Recognizing the valuable contributions from multiple audiences, including those situated in practice and research, the STEM Teacher Leader makes public their professional expertise through multiple forms.

The STEM Teacher Leader...

4.1 Regularly reviews current research and best practices for both individual STEM disciplines and STEM integration pedagogy.¹⁸

4.2 Disseminates research and evidence-based ideas through a variety of outlets with the purpose of reaching a broad audience external to the school.¹⁹

4.3 Establishes and works with STEM and STEM education networks.²⁰

4.4 Advocates for high-quality STEM education in various contexts.²¹

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1.6 Portraits of the Domains in Practice

Domain 1

Indicators

Annabelle Lopez is a 5th year middle school math teacher. She takes pride in treating all of her students fairly, holding them all to a high standard. Dedicated to her students, she always stays after school to offer extra help, but Annabelle has become frustrated that students who need extra levels of support generally do not come to see her. After conducting a review of her school, she recognizes that many students would like to stay for help, but particularly those from financially disadvantaged backgrounds are unable to do so. Reflecting on her own beliefs and assumptions about her students, she decides to seek new ideas for supporting student learning during her regular class time.

1.6

Over the past few years, she has noted that a majority of students can generally perform the algorithmic steps of solving algebraic equations, but that they struggle with new applications or conceptual explanations of the mathematics. In consultation with other math teachers, she identified an NCTM book that focuses on the teaching of equations and expressions in the middle grades. This book provides her with several strategies for introducing algebraic equations conceptually, rather than employing an initial “I do, we do, you do” instructional sequence that focuses on procedures. After this introduction, she breaks students into small groups to work on a rich math task that asks students to write in complete sentences about the relationships that exist within the given algebraic expression.

1.1

During this group work time, Annabelle is able to chart the types of thinking and skills used by her students. She hears several students having trouble making connections between particular variables and what they represent. The following day she provides small groups a task in which she provides four local contexts - the movie theater, the grocery store, the community garden, and youth center - and asks them to create an algebraic expression in one of these contexts that will be solved and explained by a different group. In reflecting on her past two weeks of teaching, she recognizes what she can do during class time that meets the diverse needs of her students more effectively.

1.5

1.4

Domain 2

Indicators

Seventh grade science teacher, Oliver Tupman, had recently worked on increasing student participation during whole group classroom discussions. After a few months of implementing different strategies Oliver thought would work best for his students, he invited his colleagues to learn more about facilitating classroom discussions. Oliver set up a monthly meeting with three other math and science teachers to discuss the strategies he tried and thought might be effective for his colleagues' classrooms. During one of their meetings, Charlotte-Hayden Wilde shares that she has been trying to implement what they have discussed, but she still has several students that refuse to talk in the whole class setting. After the meeting, Oliver asks Charlotte-Hayden if he could observe her class and help her think more about the students who are not participating.

2.1

To prepare for the observation, Oliver creates a chart of discussion facilitation moves Charlotte-Hayden has prioritized and asks for a seating chart. As he watches the lesson, Oliver documents the facilitation moves Charlotte-Hayden uses and notes particular students that respond during the lesson to particular moves. Oliver tries to document enough context to help them remember specific moments of the lesson, such as how other students seemed to respond to student ideas and phrases both Charlotte-Hayden and the student used. After the lesson, Oliver spends a few minutes reviewing his notes on the seating chart and identifying students that were not listed in his observations notes. Oliver then writes a few notes about what he remembered the students doing during the lesson.

2.3

After school, Oliver and Charlotte-Hayden meet to discuss their observations. As Charlotte-Hayden was concerned about particular students, Oliver shared his notes about the students who were not talking in the whole group setting and what the students were doing during the lesson. As they discussed the specific set of students, Charlotte-Hayden noted most of the students were bilingual learners, and she shared some of the strategies she uses in her classroom to support them. Oliver offered to find an article that describes effective strategies for supporting bilingual learners in whole group discussions. He then asks Charlotte-Hayden if he could help her incorporate one of the new strategies and share what they are working on with the other teachers at their next meeting.

2.5

Domain 3

Indicators

Cora Manalo, a fifteen year veteran of industry and now a middle school STEM teacher of different math, science, and engineering courses, represented her school at a district-wide STEM education brainstorming and planning workshop over the summer. Following this experience, she was inspired to think about how to bring more cohesion and intentionality to the STEM efforts at her school - and in particular, how to invite all students into meaningful and impactful STEM learning experiences. With the support of her principal, she sent out a survey to the school faculty to gauge familiarity, comfort, and interest in STEM, including a question where teachers could signal their level of willingness to be part of a STEM Planning Team (SPT). After the survey, Cora contacted those who said they wanted to be part of the team, ultimately bringing together one of the math teachers, all three science teachers, and one social studies teacher for regular one-hour meetings every other week.

The SPT's first task was to review the survey data from the faculty, which suggested there were several teachers already engaging students in STEM-related projects, a number of teachers who would be interested in learning more about how to bring STEM into their classrooms, and some teachers who did not see the relevance of STEM to their work. Seeing how helpful the faculty survey was to informing their work, the SPT worked with the school principal to conduct a similar survey with parents and caregivers as well as the students in their school. Findings from these surveys suggested that many parents and caregivers were very interested in more high-quality STEM experiences for their children in order to best set them up for success in the future. The student surveys revealed that younger students at the school did not know about available STEM opportunities, some had confusion around the term "STEM", and a few students felt they received messages about STEM not being for them.

Based on this data, the STEM Planning Team drafted an initial vision for high-quality STEM at their school and circulated it for feedback from key stakeholders such as their principal, the faculty, members of the Home and School Association, and student leaders in the school. Once the vision was revised and finalized, Cora and the SPT then engaged in a strategic planning process that identified ambitious yet realistic goals for the school's STEM work. In addition to providing a roadmap for moving the school's STEM efforts forward, the plan also identified essential checkpoints and milestones, which the SPT used to measure and track progress and enact changes to the plan as needed.

3.1

3.2

3.3

3.4

Domain 4

Indicators

Evelyn Magrans is a former 6th grade science teacher and has transitioned to a STEM Specialist position over the past three years. She supports and offers professional learning experiences to twelve educators at her school in grades 3-8, guiding them to implement research-based practices focused on student discourse and feedback. She has engaged in many of her own professional learning experiences where she has been exposed to research-based strategies for teaching science and math and has developed a network of colleagues from around her state and region who are thinking about and doing similar work.

Many colleagues in her network are discussing the importance of offering meaningful contexts and applications for the STEM content in which students engage. Seeking to learn more, Evelyn has been reviewing research that describes a more accessible learning experience when science and math concepts are situated in a real-world context that is relevant and meaningful to youth. She has modeled examples of such lessons in professional learning experiences for her educators, but finds that many educators are struggling to find real-world connections and make them relevant to their students. To support her colleagues, she has begun vetting existing websites and compiling phenomena connected to meaningful local and national problems into an annotated repository organized by grade level science and math disciplinary core ideas.

Throughout this process, she has found her professional networks to be incredibly helpful in finding resources and recognizing the constraints that educators face. With the help of a colleague from a past professional development experience, Evelyn has improved upon this inventory by identifying community members that may be able to speak to such relevant events at a local level and offer prompts that STEM educators might use to vet and prepare community members to talk and work with students. Evelyn and her colleague decided to collaboratively submit a proposal on this work for the annual NSTA conference. They have developed a useful tool to support educators in bringing real-world STEM contexts into their classrooms and believe that many educators would find it important as they implement integrated STEM.

4.1

4.3

4.4

Section 2: The Notre Dame STEM Teaching Fellowship

2.1 Why We Exist

STEM education has the potential to help young people flourish, especially those who are on the margins or otherwise vulnerable. STEM teachers are critical to shaping this path, but in order to fully realize this vision, STEM teachers must be empowered as leaders to exhibit instructional excellence, build capacity within their communities, advocate for sustainable improvements, and effect change at scale. The Notre Dame STEM Teaching Fellowship elevates the profession of teaching through on-going professional formation and the development of a dynamic, collaborative, national network committed to being a force for good in the world through education.

2.2 Program Essential Intent

The Notre Dame STEM Teaching Fellowship forms STEM teacher leaders who catalyze rigorous, ambitious, and sustainable STEM learning cultures for their students and school communities.



2.3 STEM Learning Culture Definition

A high quality STEM learning culture is characterized by:

- Learning communities who engage with meaningful - and when possible, socially relevant - problems that require the authentic application of STEM disciplinary core ideas and practices.
- Opportunities for learners to individually and collaboratively solve problems and make sense of the world around them.
- Curriculum and instruction that values and uses student thinking and voice to shape learning.

2.4 Program Goals

Notre Dame STEM Teaching Fellows will:

- Develop an identity as a transformational STEM Teacher Leader.
- Enact ambitious instruction that a) centers student thinking and voice and b) integrates disciplinary core ideas and practices to address socially meaningful problems.
- Cultivate a school-wide STEM learning culture that fosters student sensemaking, problem-solving, and engagement with meaningful contexts.
- Collaborate with local and national networks to build a sustainable, strategic approach to STEM education for all members of their community, particularly those who are most vulnerable or marginalized.

2.5 Program Sequence

The four program goals of the Notre Dame STEM Teaching Fellows program are far-reaching and require long-term commitment to reflection, practice, and growth. As classrooms, schools, and communities are complex systems, the domains and indicators addressed in the STEM Teacher Leadership Framework work together to support different aspects of these goals.

YEAR ONE

Domain 1: Advancing Personal Expertise

- 1.1 Increases STEM content knowledge
- 1.2 Designs STEM curriculum
- 1.3 Employs meaningful & authentic problems
- 1.4 Enacts high-quality, research-based pedagogy
- 1.5 Provides feedback & adapts instruction
- 1.6 Interrogates beliefs & practices

Domain 3: Advancing Institutional Goals

- 3.1 Identifies assets & barriers to high-quality STEM learning

YEAR TWO

Domain 2: Advancing Colleagues' Practice

- 2.1 Supports a culture of professional learning
- 2.2 Understands adult learning & dispositions
- 2.3 Provides mentoring & coaching
- 2.4 Shares educational research

Domain 3: Advancing Institutional Goals

- 3.2 Builds consensus
- 3.3 Develops strategic plans
- 3.4 Makes data-informed decisions
- 3.5 Communicates & documents effectively

The program sequence depicts how the domains and indicators unfold over the scope of the program to meet the aforementioned program goals. Domains and indicators spiral throughout the entire program. The sequence here shows where particular domains and indicators are most emphasized.

SUMMER THREE

Domain 2: Advancing Colleagues' Practice

2.5 Facilitates professional development

Domain 3: Advancing Institutional Goals

3.2 Builds consensus

3.3 Develops strategic plans

3.4 Makes data-informed decisions

3.5 Communicates & documents effectively

3.6 Stewards financial stability

SENIOR FELLOWS

Domain 1: Advancing Personal Expertise

1.1 Increases STEM content knowledge

1.2 Designs STEM curriculum

Domain 2: Advancing Colleagues' Practice

2.5 Facilitates professional development

Domain 4: Advancing the Field

4.1 Reviews research

4.2 Disseminates research and practices

4.3 Works with STEM networks

4.4 Advocates for STEM education

Appendix: Related Research

The following endnotes provide selected citations of research that supports the work in this document. These citations are not exhaustive, but provide a foundation for elements of the Framework.

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