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Demystifying Systems Change

How the NSF INCLUDES National Network is Changing Systems to Broaden Participation in STEM

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Purpose of the Brief

This is the first brief in a series focused on systems change that the NSF INCLUDES Coordination Hub will publish this year. In the brief, we provide an overview of several definitions and approaches to systems change, discuss the NSF INCLUDES vision for systems change, and illustrate how a systems change framework, developed by FSG, can be applied to the NSF INCLUDES design elements of collaborative infrastructure and associated broadening participation outcomes. The approaches we discuss in the brief are not exhaustive, but they use the context of the NSF INCLUDES National Network to demonstrate how systems change occurs, looking at examples from different programs and institutions. We hope this information will deepen readers' understanding about the levels of systems change, and how their own efforts to broaden participation in science, technology, engineering, and mathematics (STEM) reflect the principles of systems change.

Lens of Systems Change

Changing systems that hold historic and current policies and practices in place is necessary to overcome inequities and to achieve transformative and sustainable change. Since systems change shows great promise in achieving changes that last over time (FSG, 2018; Srinivasan, 2021), it is imperative that we understand what it means and the different approaches that can be used to maximize its potential. Definitions of systems change vary depending on the academic discipline and the theoretical approach. In constructing this brief, our priority was to feature multiple approaches to systems change specific to broadening participation in STEM. We also explored systems change in non-STEM fields to incorporate relevant efforts to attaining lasting changes in other related settings. We reviewed 32 resources (blogs, journal articles, reports, and toolkits) and 12 frameworks, and present four frameworks that met our selection criteria (alignment with NSF INCLUDES vision, peer-reviewed or credible source, and published within the last five years).

Literature Landscape: Approaches to Systems Change

In reviewing existing literature, we found various definitions of systems change that had these common themes:

- identifying the root causes of inequities or social problems;
- having a deliberate process to change the conditions and structures causing the problem; and
- employing a comprehensive approach to address the problem within and across multiple levels (see Appendix).

The four frameworks presented below exhibited characteristics closely aligned with NSF INCLUDES and its goals to broaden participation in STEM education and careers. Given the diversity of their focus and the variation in which they define systems change, we concluded that there is no one single way to approach systems change work. Indeed, as evidenced through the frameworks presented in Table 1, there are unifying elements of systems among the frameworks such as changing policies, practices, power dynamics, and relationships, as well as the interconnections between the elements. However, each approach has its own specific lens through which to view systems change.

Table 1. Systems Change Frameworks

Framework	Description	Elements/Conditions of Systems Change
Changing Workforce Systems, Urban Institute, 2017	The Changing Workforce Systems framework proposes concepts and measures that simplify the often-complex concept of systems change into clear processes and metrics in respect to workforce development. The framework provides insights for practitioners and funders on how to address the challenges of describing and measuring their systems change efforts, so they can monitor and report on their progress.	» Changing policy, practice, perceptions, funding, and institutions » Collaboration and relationships » Complex and multilevel initiatives » Sustained and institutionalized effects
Four Frames for Systemic Change in STEM, Reinholz & Apkarian, 2018	Four Frames for Systemic Change in STEM is an adaptation of the four-frame model of organizational change, and a tool for applied researchers and practitioners interested in studying and influencing systemic change within STEM departments. It outlines the four frames (listed in adjacent cell) and discusses how they provide perspectives into things that needs to be changed or improved (products for change) and how they need to be changed (process of change) on a university campus.	» Structures » Symbols » People » Power
Strive Together Theory of Action, Strive Together, n.d.	The StriveTogether framework has four pillars: shared community vision; evidence-based decision making; collaborative action; and investment and sustainability. The theory of action draws from a partnership with system leaders in making sustainable shifts in policies, practices, resources, and power structures to eradicate structural racism and advance equitable outcomes.	» Policies » Practices » Resources » Power
The Water of Systems Change, FSG, 2018	The Water of Systems Change framework describes three levels and six associated conditions needed to transform a system. The levels include structural change (explicit), relational change (semi-explicit), and transformative change (implicit). The authors posit that these changes must happen within and across all levels for lasting system improvements.	» Policies » Practices » Resource Flows » Relationships and Connections » Power Dynamics » Mental Models

NSF INCLUDES Approach to Systems Change

In 2011-2012, the Committee on Equal Opportunities in Science and Engineering (CEOSE) made a recommendation to the National Science Foundation (NSF) to:

> *"…implement a bold new initiative, focused on broadening participation of underrepresented groups in STEM that emphasizes institutional transformation and system change; collects and makes accessible longitudinal data; defines clear benchmarks for success; supports the translation, replication and expansion of successful broadening participation efforts; and provides significant financial support to individuals who represent the very broadened participation that we seek" (CEOSE, 2014, p.1).*

NSF INCLUDES is a bold initiative that catalyzes collaborative action to shift inequitable systems and maximize the impact of broadening participation in STEM education and careers. The initiative is designed to achieve systems change through strategic approaches that include fostering cross sector collaborations and working across non-traditional lines of authority. A key step in the theory of action is to lay a strong foundation by operationalizing the five design elements of collaborative infrastructure — shared vision; partnerships; goals and metrics; leadership and communication; and expansion, sustainability, and scale —that guide the work of participating programs. Similar to the Kania et al. (2021) call for an equity-centered focus in the collective impact model, the members of the NSF INCLUDES National Network support efforts toward advancing equity in STEM through such approaches as diversifying faculty, teachers, and education leaders, and practitioners and leaders in non-education settings; implementing culturally responsive teaching and practices; and developing new educational models and innovative research to further participation in STEM education.

The variation in definitions and approaches across the frameworks in Table 1 makes it difficult to provide "one-size fits all" recommendations for infusing systems change into efforts to broaden participation in STEM. However, we can provide a range of examples to help projects consider and reflect upon their practices. To do so, we used one of the four frameworks included in our research review, *The Water of Systems Change*, and created two exhibits that feature examples designed to help Network members think about the intersection of systems change and their own work.

FSG Framework: Conditions of Systems Change

We selected *The Water of Systems Change* framework because it conceptualizes conditions for systems change as multiple levels that are intertwined and move in a specified direction over time. This definition resonates with NSF INCLUDES' goal of building a powerful, sustainable movement that will accelerate the inclusion and advancement of traditionally underrepresented populations in STEM. This is not an endorsement of the FSG framework over the other options; we selected the FSG framework to demonstrate the relationship between NSF INCLUDES and systems change.

The FSG framework is composed of six interdependent conditions that can hold problems of inequalities in place "with varying degrees of visibility to players in the system, largely due to how explicit, or tangible, they are made to most people" (FSG, 2018, p. 3). In Table 2, we provide definitions for these six conditions and describe how they fit across the three levels of change (structural, relational, and transformative).

Table 2. FSG Framework Elements (adapted from FSG, 2018)

Levels	Conditions
Structural change (explicit): Involves shifting policies, practices, and the flow of resources	**Policies:** Government, institutional and organizational rules, regulations, and priorities that guide the entity's own and others' actions.
	Practices: Espoused activities of institutions, coalitions, networks, people, and other entities targeted to improving social and environmental progress. Also, within the entity, the procedures, guidelines, or informal shared habits that comprise their work.
	Resource Flows: How money, people, knowledge, information, and other assets such as infrastructure, and how they are allocated and distributed.
Relational change (semi-explicit): Involves disrupting power dynamics and building authentic relationships with all the right stakeholders in the system.	**Relationships and Connections:** Quality and kind of connections andcommunication occurring among actors in the system, especially among those with differing histories and viewpoints.
	Power Dynamics: The distribution of decision-making power, authority, and formal and informal influence among individuals and organizations.
Transformative change (implicit): Involves shifting internalized beliefs and assumptions that influence peoples' thinking and actions.	**Mental Models:** Habits of thought—deeply held beliefs and assumptions and taken-for-granted ways of operating that influence how we think, what we do, and how we talk.

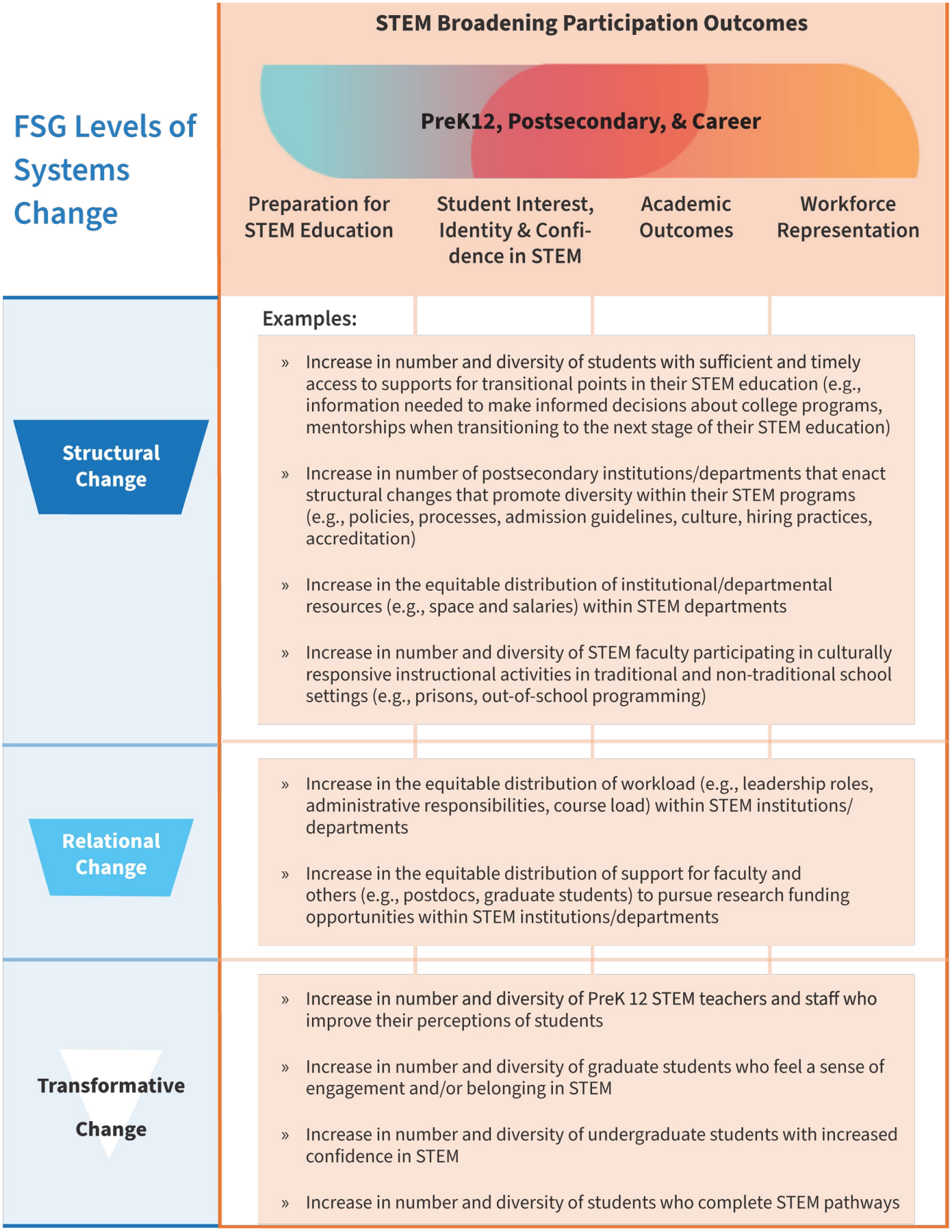
Intersection of Systems Change and NSF INCLUDES National Network Efforts

The FSG framework provides a useful structure for projects funded or co-funded by NSF INCLUDES as well as projects designed to promote diversity, equity, and inclusion in STEM. The framework enables projects to think about how their efforts reflect (or could be modified to reflect) the principles of systems change. In Exhibits 1 and 2 below, we provide examples of the types of activities and outcomes that can be observed in the intersection of systems change and INCLUDES work. These examples, adapted from the NSF INCLUDES Shared Measures Framework, illustrate how partnership-based efforts to broaden participation in STEM can embed systems change throughout their practices. Our hope is that Network members can find entry points to understand how their work relates to systems change, regardless of the maturity stage of their project and/or their particular focus areas.

Exhibit 1: Examples of Systems Change Practices Associated with the Design Elements of Collaborative Infrastructure

FSG Levels of Systems Change	Design Elements of Collaborative Infrastructure: Shared Vision; Partnerships; Goals & Metrics; Leadership & Communication; Expansion, Sustainability, & Scale
Structural Change	**Examples:** » Partners change their activities to better align with the needs of the participant population (Partnerships) » Projects and partners regularly use data to make regular improvements (Goals & Metrics) » Project decisions are informed by input from the participant population (e.g., through representation by members of the participant population on a steering committee) (Leadership & Communication)
Relational Change	» Partners reflect the diversity of their participant population (Partnerships) » Partners regularly seek advice from one another (e.g., effective strategies for addressing a given challenge) (Leadership & Communication) » The project leadership structure leverages the collective knowledge of partners and other stakeholders (Leadership & Communication) » Projects add new partners to address a given need (e.g., to access crucial expertise and/or additional participants) (Expansion, Sustainability, & Scale)
Transformative Change	» Projects work lead to a change in the narrative and traditional models (Shared Vision) » Projects use inclusive and equitable distributed leadership (Leadership & Communication)

Exhibit 2: Examples of STEM Broadening Participation Outcomes that Reflect Systems Change



Next Steps

In this brief, we provided information about how systems change can occur at different levels, and how it can manifest in all aspects of the strategies and outcomes associated with NSF INCLUDES National Network. In the next several months, we will conduct network-wide conversations that allow projects the opportunity to reflect on, and share, how their work exists at the intersection of systems change and the design elements of collaborative infrastructure—as well as the range of systems change outcomes that projects are seeking to achieve. We will also review responses to items included in the 2022 NSF INCLUDES Network Member Survey that are designed to obtain examples of how projects funded by NSF INCLUDES are addressing systems change in their work. The learnings from the survey and these conversations will inform our ongoing efforts to design and implement project activities that enhance equity and advance systems change. Please visit www.includesnetwork.org to learn more about how you can contribute to this important work.

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Appendix: Systems Change Definitions

There are many ways systems change is defined in existing research, with some common themes across these definitions. We share several definitions of systems change below:

> "…shifting the conditions including structures, practices, policies, resource flows, power dynamics, and mindsets that produce societal problems and hold them in place; typically involves cross-sector collaboration among stakeholders from public, nonprofit, philanthropic, or private institutions, as well as community constituents" (Mathematica & Equal Measure, 2021, p. 1).

> "… is about addressing the root causes of social problems, which are often intractable and embedded in networks of cause and effect. It is an intentional process designed to fundamentally alter the components and structures that cause the system to behave in a certain way" (Wharton & Evans, 2021, p.1).

> "…a holistic approach for examining complex, real-world systems, in which the focus is not on the individual components of the system but on the dynamic interrelationships between the components and on the patterns and behaviors that emerge from those interrelationships" (York et al., 2019, p.1).

> "...shifting the conditions that are holding the problem in place" (FSG, 2018, p.3).

> "...an intentional process designed to alter the status quo by shifting the function or structure of an identified system with purposeful interventions...Systems change aims to bring about lasting change by altering underlying structures and supporting mechanisms which make the system operate in a particular way. These can include policies, routines, relationships, resources, power structures and values" (New Philanthropy Capital, 2015, p.9; Taylor, 2016, p.2).

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