

# Wicked Problems in STEM Teacher Preparation

*Catalyzing Change Through Strategic Collaborations*

## Pre-Conference Preparations

Welcome to the Working Conference on Wicked Problems in STEM Teacher preparation. This conference culminates a five-year NSF-funded project to help improve science, technology, engineering, and math (STEM) teacher preparation through strategic collaborations among individuals and institutions in Washington state.

This pre-conference assignment is designed to prepare individuals and teams to address a wicked problem in STEM teacher preparation by identifying and engaging with interacting variables that influence and shape STEM teacher preparation systems. For those of you in teams, we anticipate that this assignment will be an integral part of your pre-conference team meeting.

This pre-conference work will prepare you to share with and learn from other conference participants, and most importantly, help you consider your STEM teacher preparation in new ways. During the Wicked Problems in STEM Teacher Preparation Conference, you will collaborate with diverse stakeholders from across the country to deeply analyze how variables from systems internal and external to teacher preparation interact and influence each other.

Though this may seem complex at times, we believe that by sharing ideas, contexts, and experiences, we can begin to identify strategies to address these wicked problems. We do not mean for this process to be limiting or prescriptive; we hope to provide a foundation and process for productive discussion at the conference and beyond.

If you are in a team, please remind all your team members to register on the WHOVA site by **June 4**. For more information on conference stipends and registration, visit [nextgenstemconference.org](http://nextgenstemconference.org).

## Pre-Conference Team Meeting Assignment Instructions

### PRIOR TO YOUR PRE-CONFERENCE TEAM MEETING

Please ask that every participant:

1. Print out a copy of the **figures** in this document (download and print pp. 4–7).
2. Read and reflect on the **wicked problem** statements and desired states (p. 3).

### DURING YOUR PRE-CONFERENCE MEETING

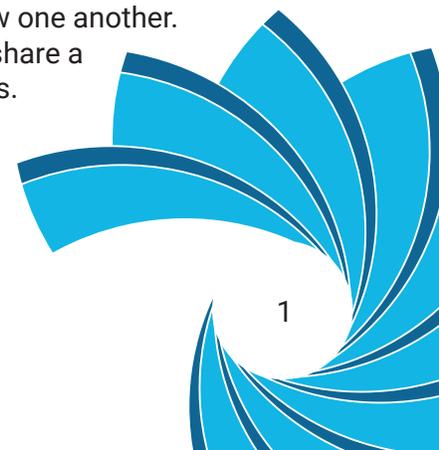
Please use tools such as Google Docs to share ideas and protocols such as think-pair-share to foster creative collaboration and the sharing of ideas. Designate one person to submit your team's responses via Google Forms at [bit.ly/preconfGF](http://bit.ly/preconfGF).

### SUGGESTED 1-HOUR AGENDA FOR PRE-CONFERENCE TEAM MEETING

*Please modify this agenda to reflect the needs and experience of your team.*

#### Introduction (~5 minutes)

Spend time getting to know one another. Introduce yourselves and share a bit about your backgrounds.



Please consider the norms of **trust, accountability, respect, and energy**, and be mindful of the various positional and relational power dynamics in your team.

### Wicked problem (~10 minutes)

Read the wicked problem statements and desired states, and select one as a group for your pre-conference tasks. Discuss how the desired state captures (or fails to capture) your team's hopes, dreams, and context. Discuss general ideas here, and be prepared to dive in further during the conference.

### Brainstorm variables and systems (~30 minutes)

Multiple variables directly and indirectly influence this wicked problem in relation to your STEM teacher preparation program, and multiple systems contribute to it. Brainstorm variables that influence your program. Collect and list both familiar variables and new variables you might not have considered previously. See **figure 1** for examples.

Next or concurrently, identify the systems within which each variable resides. Consider, for example:

- The K–12 education system
- The higher education system, including:
  - » Two-year programs and processes
  - » Four-year programs and processes
  - » Graduate programs and processes
  - » General education, majors, and minors
- Your state teacher certification and endorsement system

Loosely cluster variables by their **primary system**. Organize the variables visually to help draw connections. See **figures 2 and 3** for examples, or develop your own graphic organizer (e.g., concept map, flowchart, Venn diagram). This is your initial wicked problem system map, and it will continue to grow and shift throughout the conference.

You may find that you discover new variables and systems during this process. This activity is designed to help you recognize how variables and systems interact and impact your program. Consider which ones your team might address.

Submit your variables list and systems map to [bit.ly/preconfGF](https://bit.ly/preconfGF). Please make sure all team members have access to this work during the conference.

**Be patient with ambiguity and uncertainty!** These are wicked problems, not situations with straightforward solutions.

## Pre-Conference Assignment Instructions for Individuals Not in a Team

### SUGGESTED PROCESS

#### Wicked problem

Read the wicked problem statements and desired states, and select one for your pre-conference tasks. Consider how the desired state captures (or fails to capture) your hopes, dreams, and context. Consider general ideas here, and be prepared to dive in further during the conference.

#### Brainstorm variables and systems

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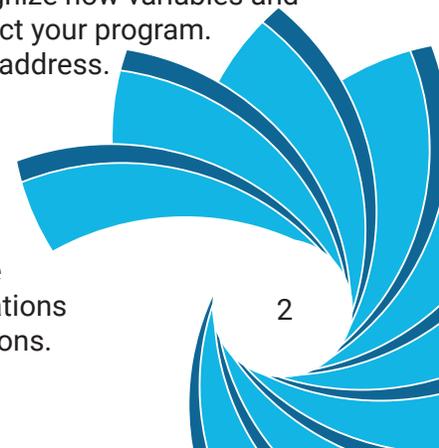
- The K–12 education system
- The higher education system, including:
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## Wicked Problems

Our Working Conference will focus on how faculty, staff, administrators, and others can disrupt the systems that perpetuate three wicked problems in STEM Teacher Preparation.

### WHAT ARE WICKED PROBLEMS?

In “Dilemmas in a general theory of planning,” Horst Rittel and Melvin Webber defined *wicked problems* as “A social or cultural issue or concern that is difficult to explain and inherently impossible to solve” (1973).

We sometimes face wicked problems where neither the problem nor the solution is clear (Alford & Head, “Wicked and Less Wicked Problems: A Typology and a Contingency Framework,” 2017).

### WHAT WICKED PROBLEMS WILL WE FOCUS ON TOGETHER?

The Working Conference on Wicked Problems in STEM Teacher Preparation will focus on three wicked problems:

- Creating racially equitable, diverse, and inclusive K–12 STEM teacher preparation programs
- Preparing and supporting all elementary teachers to be teachers of STEM
- Creating interdisciplinary and culturally sustaining secondary STEM teacher preparation programs

You may have a desired state that is in tension with the wicked problem. These statements and desired states are intended to help stimulate and focus conference discussions. They are not meant to be prescriptive.

#### Creating racially equitable, diverse, and inclusive K–12 STEM teacher preparation programs

**Problem Statement:** Many institutions of higher education do not provide STEM learning experiences to pre-service or potential pre-service teachers in culturally sustaining ways, use culturally responsive pedagogies, or have faculty who reflect students’ identities. Furthermore, a path to a STEM teaching career is often not made clear or enticing to minoritized students interested in STEM.

**Desired state:** A system in which the paths to a STEM teaching career are clear and appealing to people from historically minoritized communities, and in which pre-service or potential pre-service teachers encounter culturally sustaining and culturally responsive STEM teaching. Graduates of teacher prep programs use curricula and teach STEM in ways that sustain and affirm cultures and racial

equity, linguistic access, build and promote students’ STEM identities, and reflect the demographics of the students they teach.

#### Preparing and supporting all elementary teachers to be teachers of STEM

**Problem Statement:** Most U.S. elementary schools are not able to provide their students with consistent, culturally sustaining, and personally meaningful NGSS/CCSS-based STEM learning experiences.

**Desired state:** A system that graduates elementary teachers and administrators who regularly provide their students with consistent, culturally sustaining, and meaningful NGSS/CCSS-based STEM learning experiences so that each learner constructs an identity as STEM-capable and develops coherent conceptual understanding.

#### Creating interdisciplinary and culturally sustaining secondary STEM teacher preparation programs

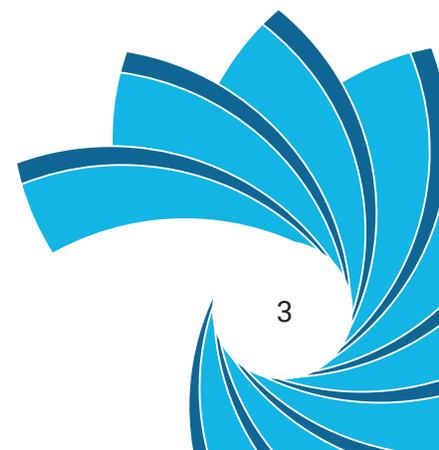
**Problem statement:** Many secondary (6th through 12th grade) schools currently do not provide students with STEM learning experiences that reflect the relevant and interdisciplinary nature of problems in the world beyond the classroom.

**Desired state:** A system that graduates secondary teachers and administrators who regularly provide every student in 6th through 12th grade with meaningful and culturally sustaining STEM learning experiences that help students make sense of the interdisciplinary nature of the world.

### NEXT STEPS

After you have chosen your wicked problem, begin brainstorming:

- The **variables** that directly or indirectly influence this wicked problem in relation to your teacher preparation program.
- The **systems** within which each variable resides. Some variables may fit within multiple systems.

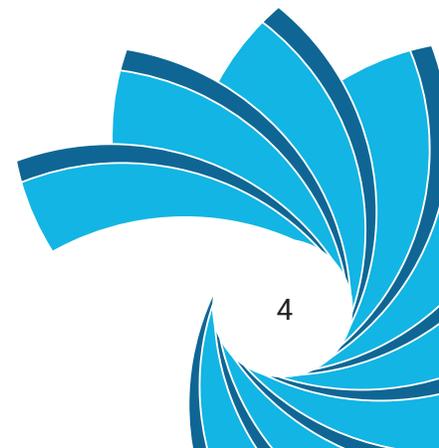


# Variables

Brainstorm variables that influence your Wicked Problem. Consider variables related to people, programs, policies, and resources (variables may overlap). Consider both current and aspirational variables.

<b>People</b> <i>Individuals and roles</i>	<b>Programs and Practices</b>	<b>Policies</b> <i>Federal, state, institutional, departmental, course</i>	<b>Resources</b> <i>Non-human</i>
<b>Examples:</b> <ul style="list-style-type: none"> <li>• Students' interest in STEM teaching</li> <li>• # of STEM ed faculty, K-12 mentor teachers</li> <li>• Consistency of advice from admissions and guidance counselors</li> <li>• Level/type of support from administrators</li> <li>• # of STEM/Educ faculty of color</li> <li>• Views of students' STEM peers about teaching</li> <li>• ...</li> </ul>	<b>Examples:</b> <ul style="list-style-type: none"> <li>• Advising policies and practices</li> <li>• Available STEM majors and minors</li> <li>• Education majors and minors, Bridge to college programs</li> <li>• Aspects of departmental culture</li> <li>• Culturally sustaining practices and pedagogies</li> <li>• STEM faculty attitude toward teaching careers</li> <li>• Education faculty attitude toward STEM</li> <li>• ...</li> </ul>	<b>Examples:</b> <ul style="list-style-type: none"> <li>• Course placement policies</li> <li>• Graduation requirements</li> <li>• Admission to major</li> <li>• Admission to School of Ed requirements</li> <li>• State standards</li> <li>• EdTPA</li> <li>• ...</li> </ul>	<b>Examples:</b> <ul style="list-style-type: none"> <li>• Curriculum (K-12 and higher ed)</li> <li>• Courses</li> <li>• Access to high speed internet, tutoring centers, financial aid, diversity centers, healthcare, etc.</li> <li>• Advising documents for students</li> <li>• Advising documents for faculty</li> <li>• Partnerships with K-12 schools and cooperating teachers</li> <li>• ...</li> </ul>
<b>Variables:</b>	<b>Variables:</b>	<b>Variables:</b>	<b>Variables:</b>

Additional notes:



# Systems & Variables

Consider the systems that impact, are part of, or intersect with your STEM teacher preparation program in relation to the wicked problem you or your team selected.

Loosely cluster variables you identified by the primary system in which they reside. Organize the systems in such a way that you can draw connections and spark new ideas. Use figures 2, 3, and 4 as examples to create your own graphic organizers or systems map.

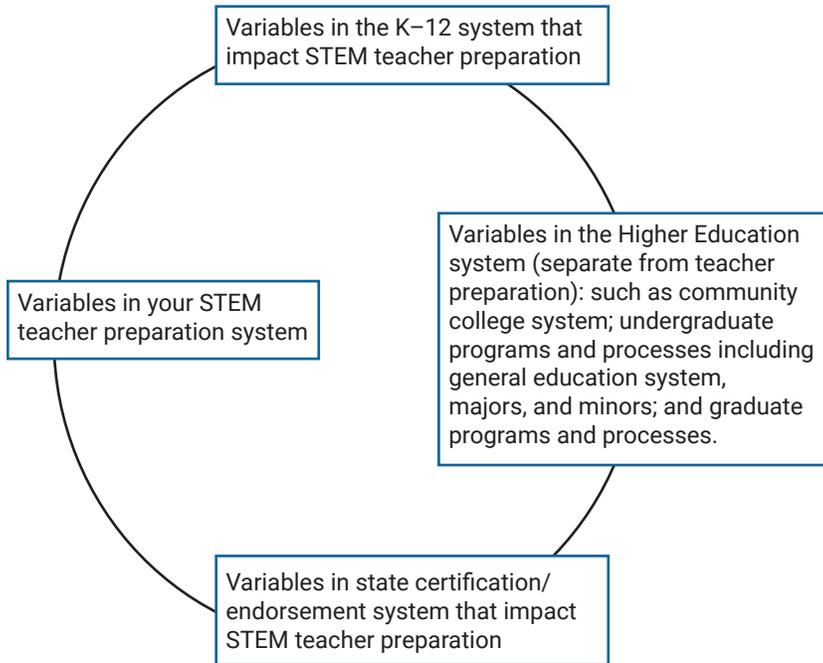


Figure 2. List your systems and group your variables in their corresponding areas.

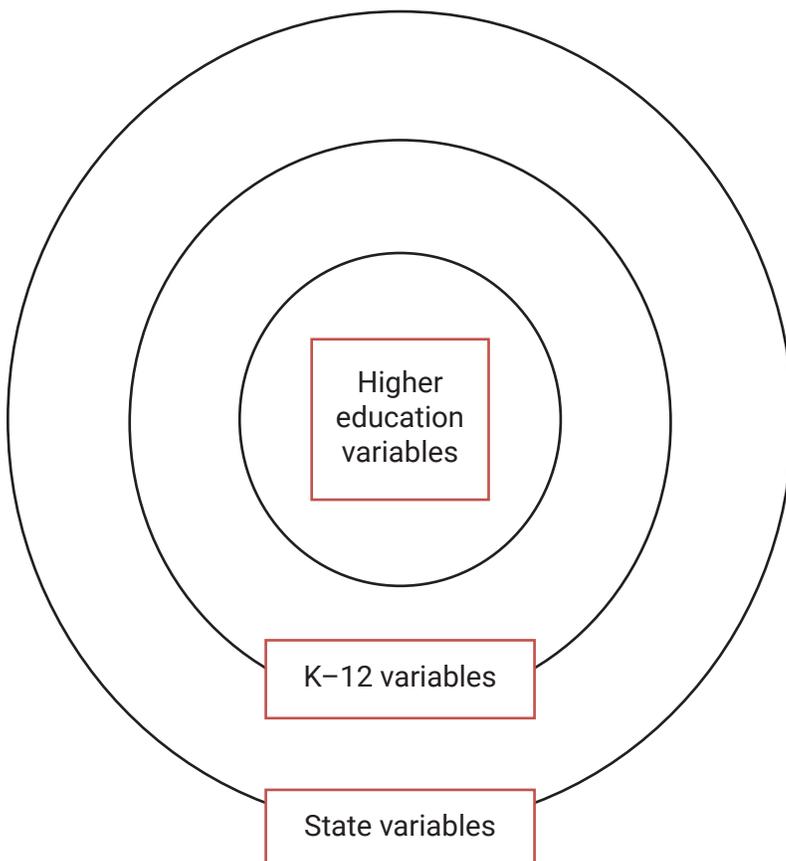
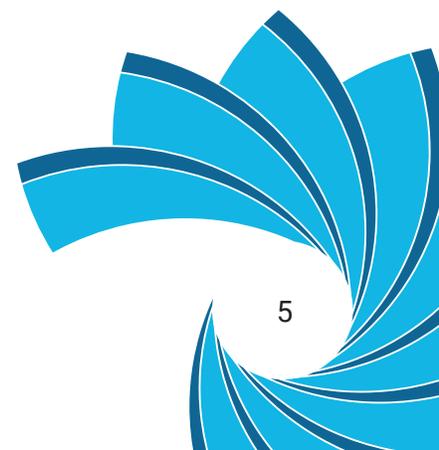
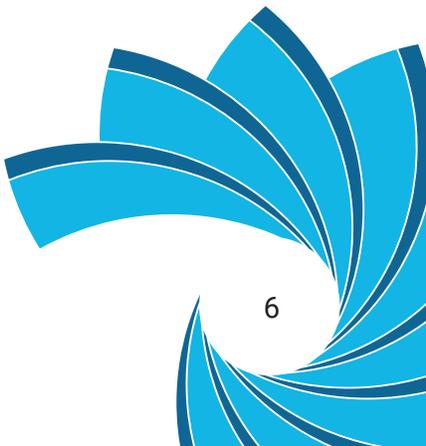
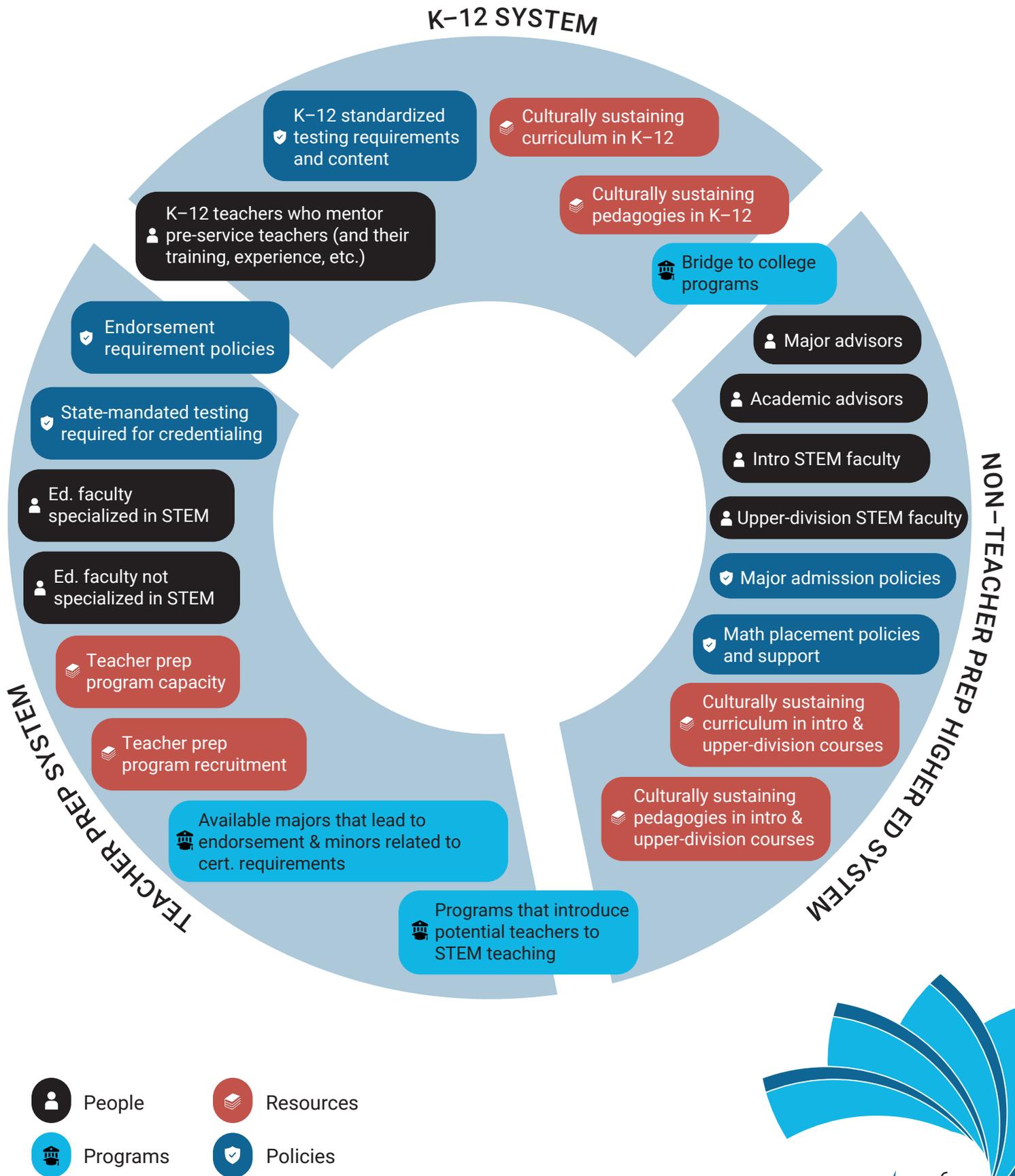


Figure 3. List your systems and group your variables in their corresponding areas.



# Figure 4. Systems and Variables

An example of clustering variables into the three systems identified. Some variables may be located within multiple systems.



## Systems & Variables

*Use this space to create your own systems map or other graphic representation of the systems and variables present in your STEM teacher preparation program.*

