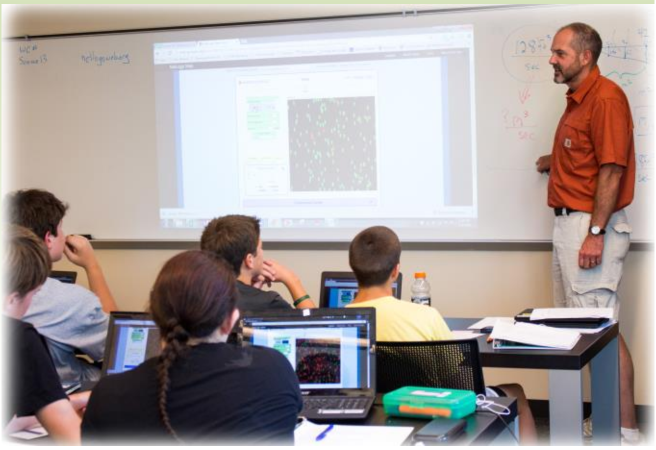
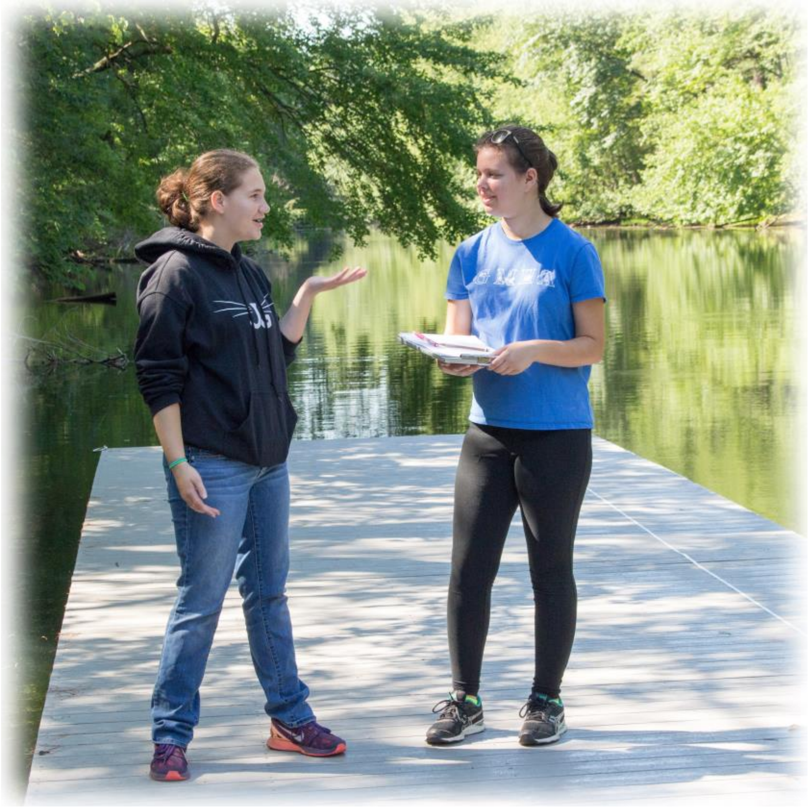
Mathematical and Computational Methods for Planning a Sustainable Future

*The **PS-Future project** is developing modules for high school classrooms that engage students in sustainability topics of personal relevance while illustrating the use of mathematical and computational methods in many facets of planning for sustainability.*

PS-Future Activities

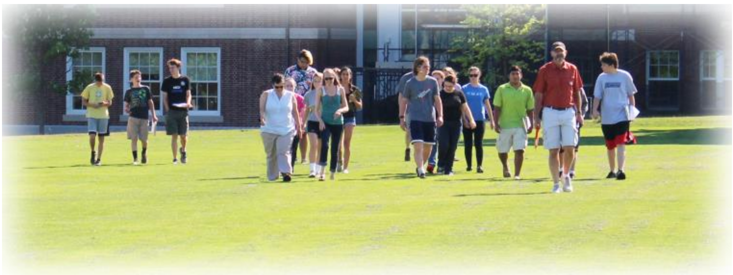
- Developing, testing, and implementing experimental one-week instructional modules for grades 9-12 that engage students in planning for sustainability and highlight employment related to each topic
- Conducting research that informs presentation within the modules to enhance students' learning and transfer of key concepts
- Hosting a summer workshop for students to assist authors in writing the modules and teachers in teaching them
- Evaluating the effectiveness of PS-Future materials in attracting a diverse population of learners to STEM disciplines
- Widely disseminating the materials we create





***Planning for sustainability** seeks to identify practices that can be continued indefinitely without critically damaging natural resources, people, or economies, especially those at risk.*

- *It is forward looking.*
- *It involves making decisions about how we use today's limited resources in light of the continuing future needs for those resources.*
- *It is multi-disciplinary, involving understanding of physical and biological processes that are overlaid by human social, political, and economic concerns.*
- *It is imperative.*



PS-Future Partners

- Rutgers University (PI: Midge Cozzens; co-PIs: Tamra Carpenter, Rebecca Jordan, Hal Salzman)
- Consortium for Mathematics and its Applications COMAP (Lead: Solomon Garfunkel)
- The Groton School (Lead: David Black)
- Colorado State University (Lead: Laura McMeeking)
- Additional high schools in GA, MO, MT, VA

PI: Margaret (Midge) Cozzens
midgec@dimacs.rutgers.edu
NSF awards: DRL-1503414
DRL-1220022 (past)

DIMACS

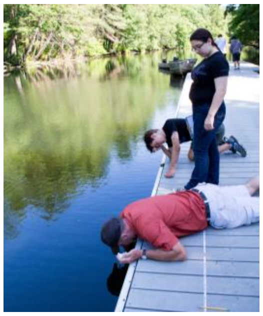
PS-Future Modules

Passive Solar Building Design – engages students in designing energy-efficient buildings using right-triangle trigonometry. Students learn about the seasonal change in the angle of elevation of the sun and how it can be used to let in or keep out the sun for energy efficiency. They also experiment with different materials to observe their heat absorption properties. (In field test)

Weather Generators – introduces students to "weather generators" for simulating weather data, such as future precipitation in various locations. Students learn about the concept of statistical persistence in weather and the critical link between weather, the water cycle, and global sustainability. (In field test)

Going Batty – examines the many important roles that bats play in the ecosystem and how they are now threatened by White Nose Syndrome (WNS). The module introduces the SIR (Susceptible, Infected, Removed) model to study WNS. Students learn about the effect of diminished bat populations on ecosystems and humans, and they use spreadsheet-based simulations to model disease progression and explore the effect of proposed strategies for combatting the disease. (In field test)

Alien Invaders – looks at the ecological impact of both plant and animal invasive species. Students learn about how an invasive population grows and spreads across a geographic landscape, and they do quantitative assessments and simulations using different rules for population growth and spatial spread. Students model strategies for controlling the spread of an invasive species and discuss why some succeed while others do not. (In field test)



Water Games – uses concepts drawn from mathematical game theory to model competition for water and other scarce resources and to examine potential strategies available to parties in conflict. Students use game theory to predict outcomes based on play of a game and to change outcomes by changing associated payoffs. (In field test)

Water and the Hydrologic Cycle – explores the interconnectedness of ground water and surface water. Students explore what it really means to get one inch of rain and how it differs between rural and urban areas. Students investigate rates of flow, runoff from rain on permeable and impermeable surfaces, and the use of greenspace, catchment areas, or other means of storm water management. (In field test)

Habitat Fragmentation – considers preserving habitat for threatened species as an issue in land use and conservation. It involves students in computing the size of protected areas, both in terms of total area and boundary length, and it explores relationships between the size of a protected area and its biodiversity. The students are exposed to ideas in land use policy through a case study on protection of the grizzly bear. (Available for field test)

Urban Sustainability – introduces basic concepts in the use of geographic information systems (GIS) to explore patterns of greenhouse gas (GHG) emissions both across and within US cities, as well as changes over time. Students also map heat in both urban and rural areas and consider links with land use and GHG emissions. (Available for field test)

Ecosystem Services – immerses students in making decisions on forest resource management. The module introduces students to sampling methods to assess forest resources and potential timber values, while also considering the value of ecosystem services like erosion prevention, carbon sequestration, and habitat provision. It illustrates that sustainable management of a natural ecosystem requires a full accounting of all effects of an action—both direct and indirect—over time. (Available for field test)

Not in My Backyard – explores how to consider social and environmental justice when making decisions like where to put a toxic waste dump. Often such facilities are located in economically depressed areas, based on priorities that further disadvantage those who are already disadvantaged. (Available for field test)