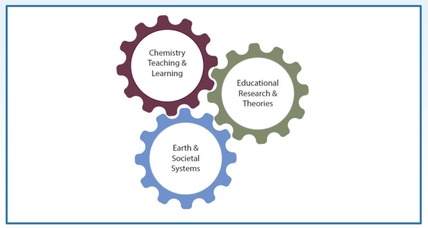

Systems Thinking in Chemistry Education

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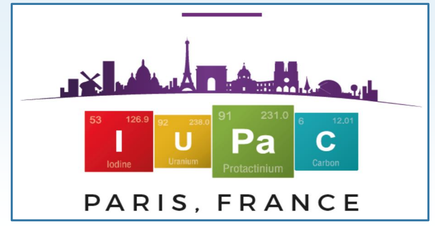


What is Systems Thinking (ST)?

A **system** comprises a set of elements working together to form a complex whole that produces a function. **ST** uses **tools, strategies, and cognitive frameworks** to:

- Visualize **interconnections and relationships among components** of complex, dynamic systems.
- Examine how **system behavior changes over time**.
- Understand how **systems-level phenomena emerge** from interactions among the system parts.

Why ST in Chemistry Education?

- Specialized chemistry knowledge is key in addressing multiple emerging global challenges
- Traditional chemistry education often characterized by reductionist presentation of isolated facts
- **More than fractionated knowledge** needed for chemistry to address complex challenges
- **Systems thinking in chemistry:**
  - Assists integrated and holistic understanding of chemistry
  - Considers both the systems of learning for students and the systems in which chemical reactions and processes take place.
  - Enhances chemists' capacities to contribute to addressing the complex challenges of sustainable development.

Contributing Members

Acknowledgements

- Project Support IUPAC and the International Organization for Chemical Sciences in Development (IOCD: Project No. 2017-C4S-ST).
- McKenzie Tilstra for assistance in preparing this poster

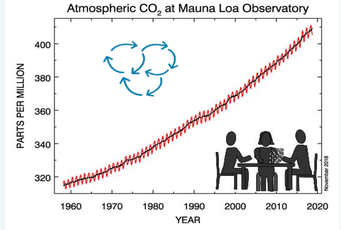
Framework for Systems Thinking in Chemistry Education

Features of learning processes applied to the unique challenges of learning chemistry

Chemistry teaching and learning

Learner systems

Theoretical frameworks of learning, learning progressions and the social contexts for learning



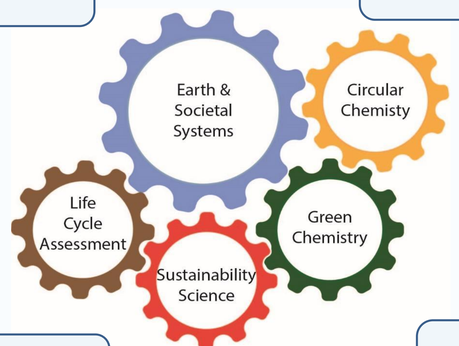
Earth and societal systems

Elements that orient chemistry education toward meeting societal and environmental needs

Molecular Basis of Sustainability

Recognize the **material basis of society** as a core element in sustainability challenges.

Shape the **practice of chemistry** by sustainability science



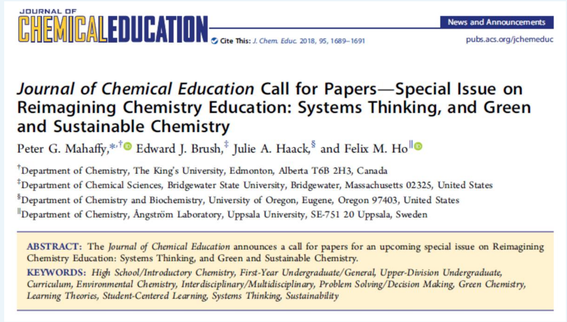
Educate about the ***molecular basis of sustainability** using **systems thinking**

Reorient **chemistry education** to address the sustainability of earth and societal systems

Progress to Date

- Definition of ST and purpose of STICE
- Preliminary Framework
- Review of ST in other fields
- Dealing with complexity
- ST skills and competencies
- ST tools and visualizations
- ST to address global challenges
- Learning frameworks to guide use of STICE
- STICE and educational standards
- Need for coherent student assessments for STICE

J. Chem. Educ. Special Issue (2019)



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Journal of Chemical Education **Call for Papers—Special Issue on Reimagining Chemistry Education: Systems Thinking, and Green and Sustainable Chemistry**

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ABSTRACT: The *Journal of Chemical Education* announces a call for papers for an upcoming special issue on Reimagining Chemistry Education: Systems Thinking, and Green and Sustainable Chemistry.

KEYWORDS: *High School/Introductory Chemistry, First-Year Undergraduate/General, Upper-Division Undergraduate, Curriculum, Environmental Chemistry, Interdisciplinary/Multidisciplinary, Problem Solving/Decision Making, Green Chemistry, Learning Theories, Student-Centered Learning, Systems Thinking, Sustainability*

Future Directions

- Identifying target educational levels and groups
- Resourcing chemistry educators and students
- Identifying chemistry education research agendas to provide solid grounding, e.g.:
  - Learning frameworks
  - Social contexts
  - Assess impact of curricular innovations

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