Restructuring Middle School Science around Grand Challenges

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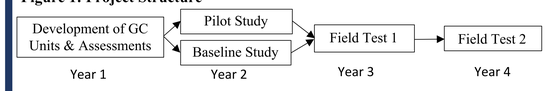
Project Overview

- Design & Development Project in the Learning strand
- **Major Assumptions**
  - Science education has failed to connect with students' lives, interests, and concerns.
  - Students' motivation to engage with science and attitudes toward science decrease significantly during late elementary and middle school.
  - Students have demonstrated growing concern with GCs.
  - School science tends to focus on conveying scientific principles with little or no connections to GCs.

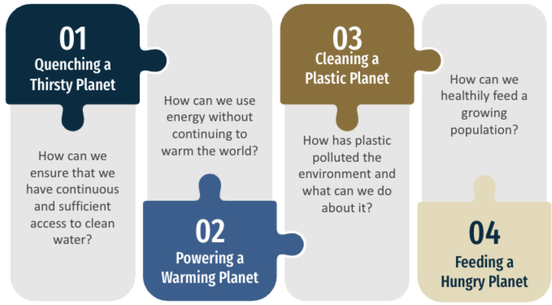
- **Long-term Aim**: *Restructure middle school science education around GCs and students' desire to be well-informed and to develop agency with respect to these issues.*
- **Goals**
  - I. Develop four GC units with associated assessments, to be interspersed throughout 7th grade science.
  - II. Collaborate with middle school teachers to enact, study, and revise the GC units.
  - III. Conduct research on student outcomes associated with the GC units and factors that impact the feasibility and quality of GC-oriented learning experiences in middle school science.
- **Research Questions**
  1. How do GC-oriented learning experiences impact middle school students' interest in and motivation to engage with science?
  2. How do GC-oriented learning experiences impact middle school students' science knowledge?
  3. What role do national assessment contexts play in enactment of and results from GC-oriented learning experiences in middle school science?
  4. How does teacher experience enacting GC-oriented learning experiences impact the enactment of and results from GC-oriented learning experiences in middle school science?
- **Project design**
  - Curriculum development of four coordinated GC units and accompanying assessments
  - Teacher professional learning opportunities
  - Classroom enactment of GC units
  - Research associated with student learning in the context of GC units and classroom enactments
  - Comparisons between enactments in US and Israel

Figure 1: Project Structure



Grand Challenges (GCs):
Global socio-scientific issues with varying local implications. Scientific ideas, principles, and evidence are essential for addressing GCs, but they do not suffice to determine solutions because of the multi-faceted nature of the issues.

Examples: Climate change, pandemics, loss of biodiversity, plastic pollution



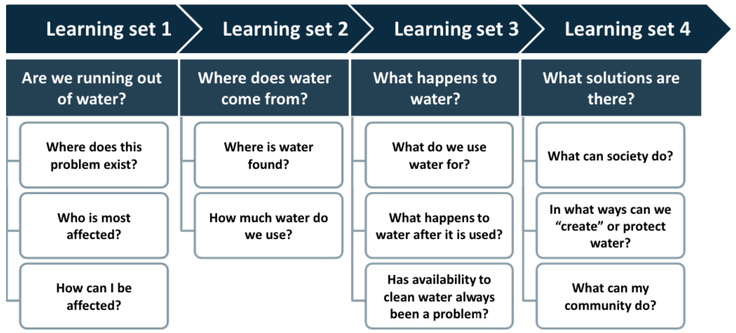
Grand Challenge Units

Sample Unit: Quenching a Thirsty Planet

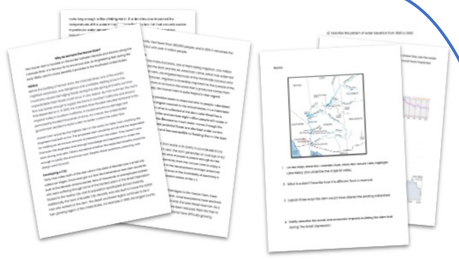
Storyline:

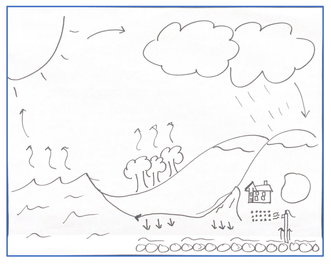
Driving Question: How can we ensure that we have continuous and sufficient access to clean water?

Standards Aligned: NC state standard: Understand the hydrosphere and the impact of humans on local systems and the effects of the hydrosphere on humans.
NGSS-ESS2.C: The Roles of water in Earth's surface processes.

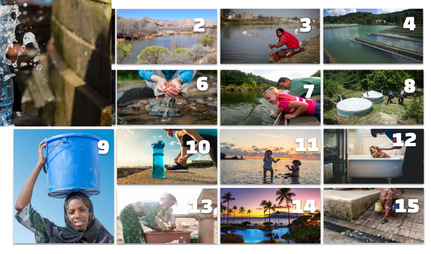


Detailed Lesson Plans:





Learning Opportunities Contextualized in Global and Local Examples



Opportunities for Student Engagement in Scientific Practices such as Modeling, Argumentation, and Explanation.

Other Unit Features:

- Educative supports for teachers
- Formative & summative assessments
- Opportunities to analyze public data

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Refer to our project website for updates and materials:
https://stweizmann.proj.ac.il/grand-challenges/

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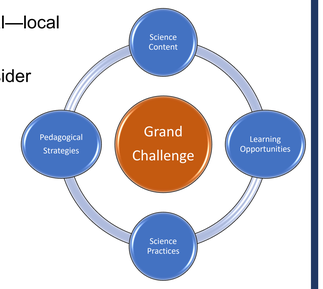
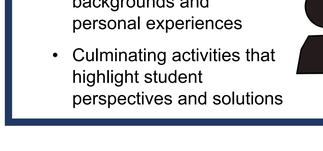
Design Principles

Key features incorporated in all GC units—the combination help to define GC-oriented Education.

- **Learning experiences contextualized in the issue**
  - Attention to the global—local dynamic
  - Opportunities to consider political, economic & ethical dimensions
  - Explore affordances and limitations of science for finding solutions

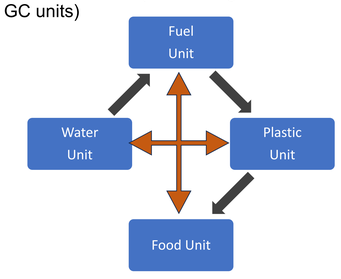


- **Practice oriented**
  - Opportunities to engage in epistemic practices like modeling, argumentation, and explanation
  - Students engage in scientific investigations
  - Access and use public data



- **Culturally responsive**
  - Address equity issues
  - Promote social justice
  - Relate to student experiences with explicit connections to home and community

- **Inter-Unit Coherence** (Connecting with and building on other GC units)



- **Prioritize Student Voice**
  - Development of agency and action
  - Classroom discourse
  - Draw upon student backgrounds and personal experiences
  - Culminating activities that highlight student perspectives and solutions