

Supporting Secondary Students Earth Science Knowledge and Engineering Design Skills with Mobile Design Studio

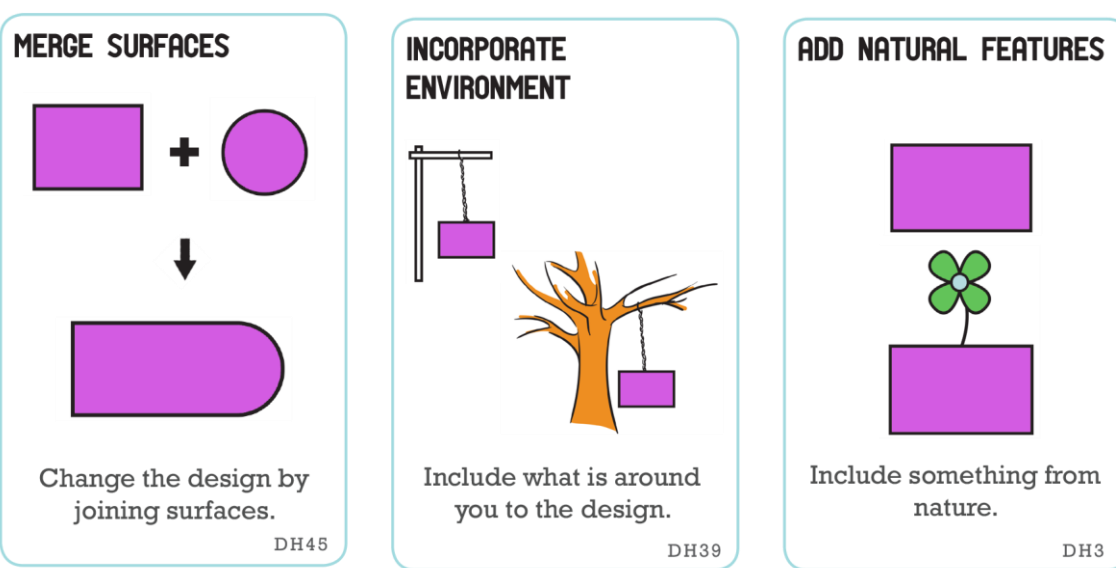
Project Objectives

1. Conduct **fundamental** and **design-based** research with secondary students
2. Develop design challenges for complex **Earth science** problems
3. Develop Mobile Design Studio as a Collaborative **Front-End Design** Platform
4. Develop and integrate an **AI-powered** design mentor

Research Questions

RQ1: How do students engage in design thinking in the project? What informed designer behaviors related to social and contextual awareness and creativity are promoted through the intervention?

RQ2: In what ways and to what extent do students integrate science, engineering, and social considerations, into their understanding of the problem, concept generation and justification?



Design Heuristic Cards Example

RQ3: How do students interact with the design mentor while designing, and to what extent do students' design practices, and STEM integration outcomes differ across versions of the design mentor?

RQ4: In what ways and to what extent do these design activities, impact students' interests, perceptions of science and engineering and engineering self-efficacy?

What We've Done So Far

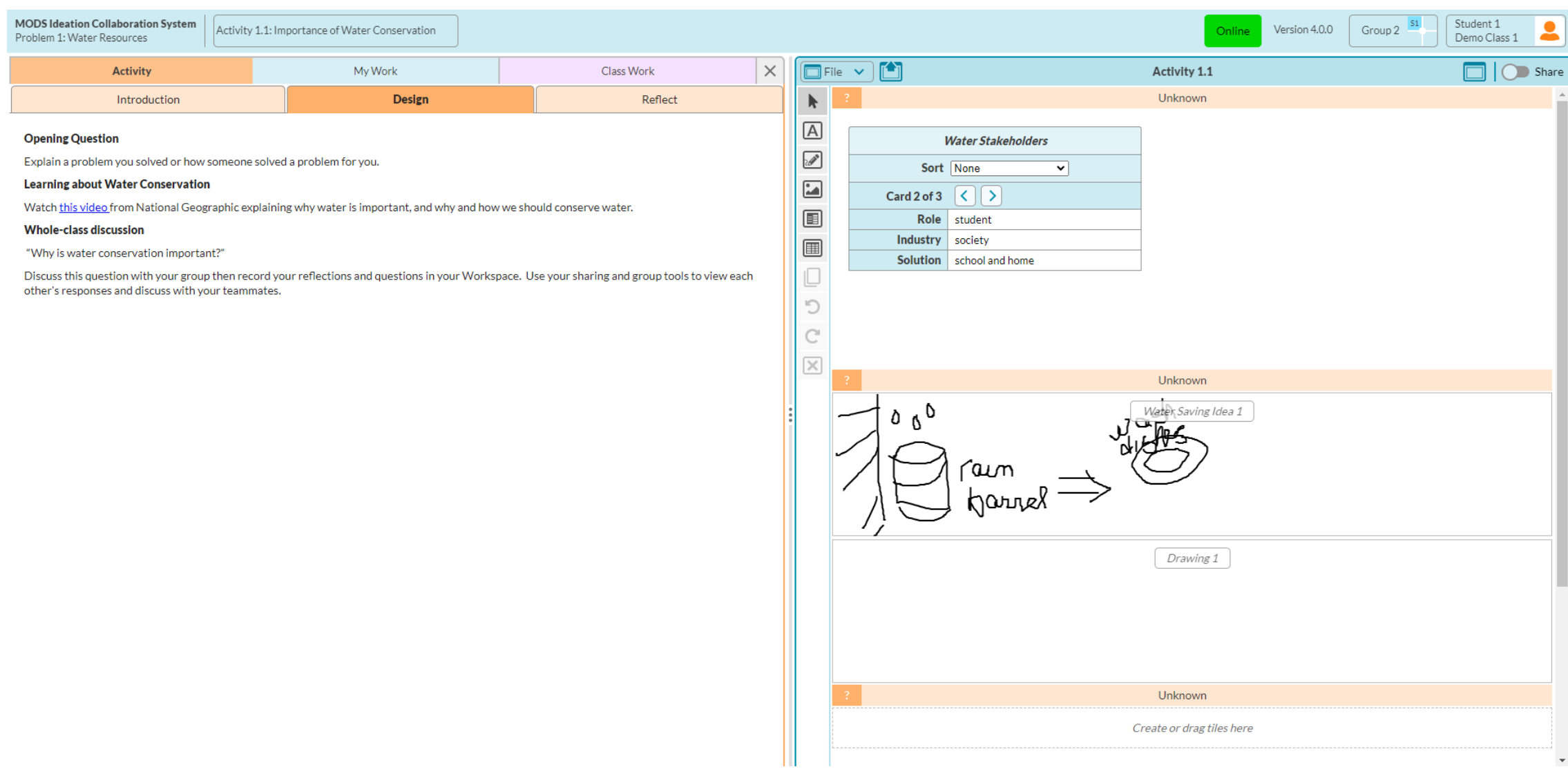
Problem Statement In what ways can your community access water through collecting it, reducing its use, or leveraging other resources?		
Lesson Title and Objectives	Main Activities	Deliverables
1.1 Importance of Water Conservation Students will be able to explain at least one reason why water conservation is important in their lives and/or communities.	→ Reading about water conservation → Small group and whole class discussion → Introducing a problem statement	Engineer notebook: Why is water conservation important to me and my community?
1.2 Stakeholder Mapping Students will be able to identify at least five stakeholders. Students will be able to identify commonalities among groups of stakeholders.	→ Creating a stakeholder map → Reframing the problem statement	Stakeholder map Notes in engineer notebook
1.3 Scoping Students will be able to organize factors they find most relevant to the design problem in a scoping table.	→ Whole-class listing of different factors → Creating a scoping table	Scoping table Notes in engineer notebook
1.4 Stakeholder Interviews Students will be able to craft at least three interview questions. Students will be able to analyze interview data to determine at least one need for their design solution.	→ Developing interview questions → Conducting short interviews with other students → Reading data to learn new things and develop requirements	Interview Interview data Needs, written Notes in engineer notebook
1.5 Research Learning Objectives: Students will be able to discuss solutions to water conservation. Students will be able to craft additional needs based on research (if needed).	→ Reading infographics about water conservation solutions → Crafting "I wonder" statements → Independent research	Research notes Notes in engineer notebook
1.6 Concept Generation, Drawing Ideas Students will be able to sketch five or more solutions to the design problem that meet the needs they identified	→ Ideating with multiple strategies <ul style="list-style-type: none">Design HeuristicsRadical and Incremental Framing	5 or more design sketches Notes in engineer notebook
1.7 Presentation & Reflection Students will be able to explain their design story.	→ Explaining most important moments in the design process. → Providing feedback to other students → Reflecting in their engineer notebook	Storyboard Oral presentation Engineer notebook

Curriculum Overview

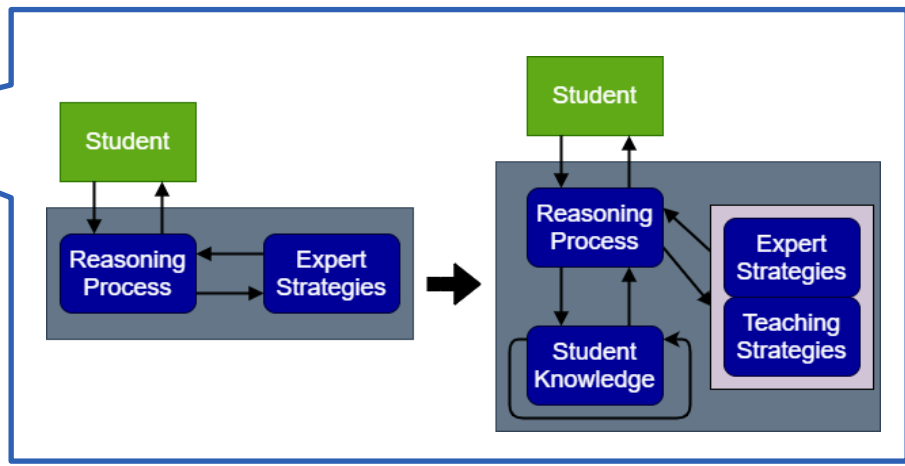
	2022			2023											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Technology Development															
MODS design methods vision and benchmarking															
Design mentor research and conceptualization															
MODS design methods development															
Design mentor development															
Curriculum Development															
Envisioning engineering design challenges															
Co-design of curriculum with expert teachers															
Professional development planning															
Research Design															
Initial user testing															
Teacher professional development training															
Initial piloting															

Development Plan

MODS & Design Mentor



MODS student interface view

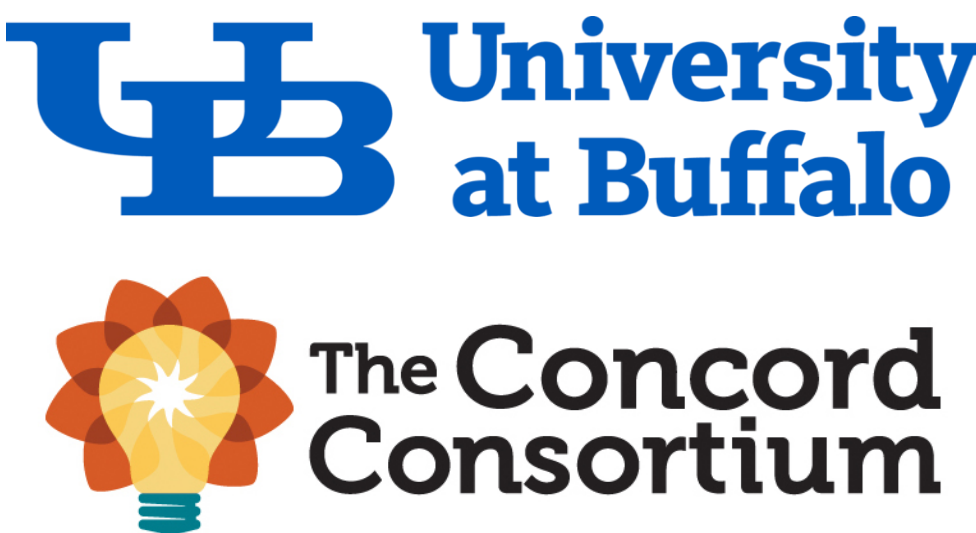


Agent Architecture

Design Mentor

Research Team & Acknowledgements

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