

## Sol y Agua Project: Enhancing Middle School Education through Computing with an Emphasis on Simulation and Data Science

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### Abstract

Between 2010 and 2012, only 19% of all college students nationwide were Hispanic. Only 6% of the STEM workforce is Hispanic[1]. Through NSF funding and a collaboration with the Smithsonian Latino Center[2], we aim to attract students to STEM fields by augmenting STEM learning modules with a culturally relevant educational game. The goal of the Sol y Agua project is to improve students' ability to learn, seek evidence, and modify or challenge beliefs through interactive game-play. The project is accomplishing this through the development of a prototype educational game for middle-school students. The game centers on data science with a theme of water sustainability and stewardship with an emphasis on information analysis, negotiation, and decision making. It will immerse students in regional issues concerning biodiversity, sustainability, and the human impact on the environment.

### Goals and Objectives

The goals for the project are to: 1) immerse middle school students in regional issues through interactive gameplay and 2) stimulate students' interests in STEM fields and careers.

The objectives for the project include: 1) design activities that require students to discover and analyze data from disparate sources; 2) expose students to water conservation issues in the Southwest region; and 3) define scenarios in which students practice decision-making skills, reconcile aspects of competing interests in real-world projects, and work in cooperative teams.

### Approach

The team constructed storylines that incorporated various components into the project including a strong STEM base, information (overload), regional data, cultural backgrounds, and themes of water conservation and sustainability. One storyline is being used for the prototype. The storyline has been broken into mini-games: activities with particular focus on one or multiple components. The team developed the Activity Hierarchy Structure (Fig. 2) to keep track of the activities while maintaining modularity.

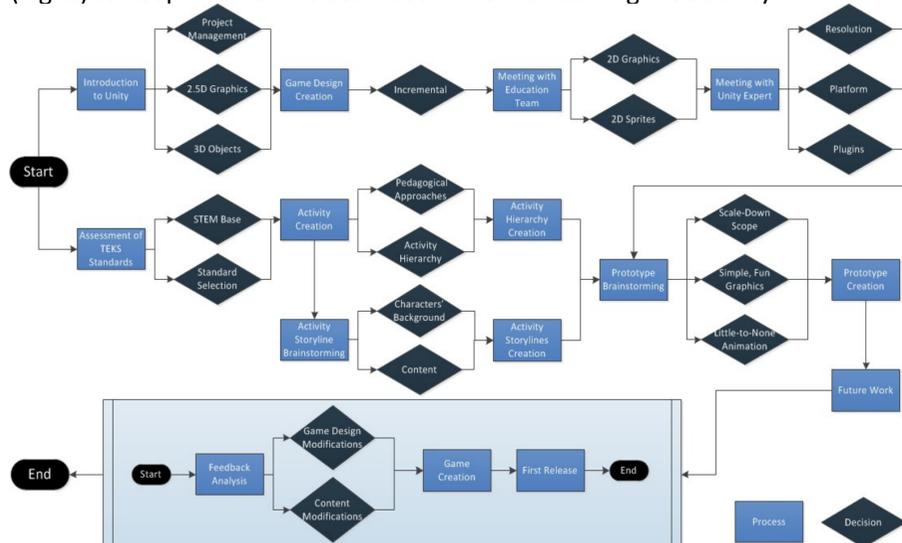
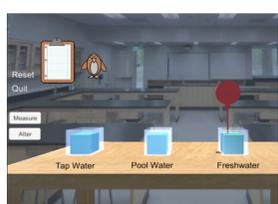


Figure 1: Game Development Process

The game development process (Fig. 1) was used to integrate digital and educational aspects within the game. The team concurrently worked on the game design and content before the development of the prototype.



pH Measure



Plant Selection



Character Sprites

### Summary

The prototype game currently intertwines game and classroom activities. The structure will allow educators to select activities based on their lesson plans. The Activity Hierarchy not only makes the project highly modular, but also personalized for students' educational needs. The Activity Hierarchy allows us to incorporate decision-making within the game, unlike most educational games. We are working with educators to evaluate the game prototype and receive feedback from both educators and students.

### Overview

The project has included the following tasks:

- analysis of educational and non-educational games with a focus on design aspects and an emphasis on features driven by educational activities
- development of scenarios to compose mini-games that map to activities, where some activities incorporate sensorial immersion through simulation while others incorporate decision-making strategies
- design of the game characters to have visual similarities to the demographics of the southwest region of the U.S.
- design of an Activity Hierarchy, a structure that organizes activities based on subject, pedagogical approach(es), content, and prerequisites.

### Activity Hierarchy

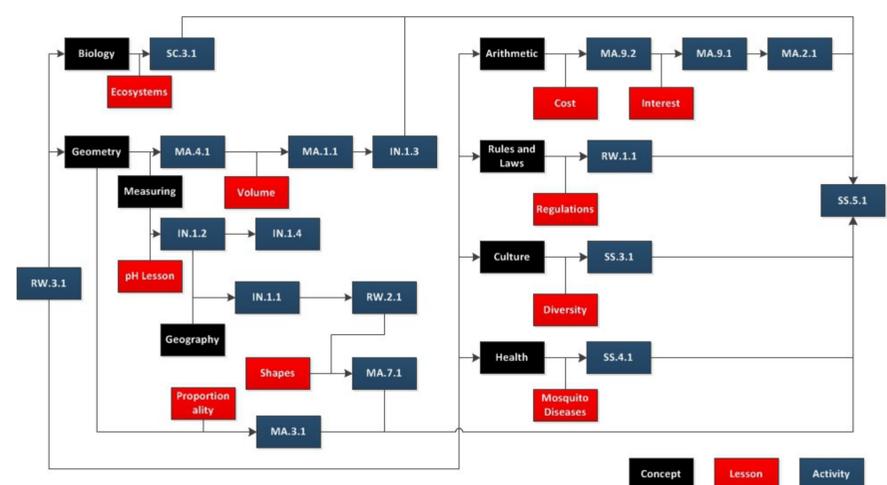


Figure 2: Activity Hierarchy Structure

The activity hierarchy (Fig. 2) serves as an organizational tool that allows the development team to connect the content different activities in a way that makes the game adaptable for the teachers by selecting and deselecting activities while maintaining a flexible structure and flow of the game. The hierarchy serves as a lesson plan for the game that educators can use to align lessons with the game. All activities are mapped to the Texas Essential Knowledge and Skills (TEKS) standards[3].

The prototype storyline has an emphasis on developing a sustainable park design for local reclaimed lots. Mini-activities supporting the storyline include simulation of pH-level measurement in water and soil, selection of native plants, and design of pipe and flora layout. Users will be given a fixed budget and information on local plants including their water consumption, cost, and popularity. The user will need to make decisions based on information provided and their performance will be assessed.

The activities were created with a focus on water conservation and sustainability. Activities were based on curricular standards from TEKS with the use of different pedagogical approaches depending on the activity subject, type, and content. The corresponding activity storylines engage students on a cultural level.

### Acknowledgements & References

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- Stacey Fox, Smithsonian Latino Center Instructional Designer/Artist.

References:

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