Middle School CS in Science

Overview

Code.org is partnering with the award-winning Project GUTS to deliver a middle school science program consisting of four curricular units and professional development for the introduction of computer science concepts into science classrooms. The goal of the middle school program is to situate computer science practices and concepts within the context of life, physical, and earth sciences and prepare students to pursue formal, year-long courses in computer science during high school. Code.org's middle school science program uses computer science as a tool to more deeply explore STEM concepts while addressing course standards. All lesson resources are aligned to the Next Generation Science Standards (NGSS), are designed to replace existing units without the need for additional class time, and leverage years of research funded through the National Science Foundation (NSF). All curriculum resources and professional development are provided at no cost to schools.

Science Content and Curriculum

Code.org's middle school science program connects computer science to science through computer modeling and simulation. Based on a crosswalk identifying areas of overlap between the NGSS and Computer Science Teachers Association K-12 Computer Science Standards, the modules address performance expectations in both standards. The introductory module introduces computer modeling and simulation, while the following three modules replace existing modules in Earth, Life and Physical Science. Each module consists of five lessons that augment educational outcomes of traditional science instruction to include computational thinking in the process of modeling and simulation.

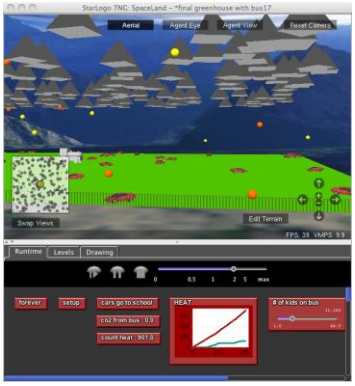
Module 1: Introduction to Computer Modeling and Simulation.

This module introduces basic concepts in modeling complex systems through hands-on activities and participatory simulations. A scaffolded series of highly-engaging design and build activities guide students through developing their first computer model in StarLogo Nova, a modeling and simulation environment developed at Massachusetts Institute of Technology.

Students practice designing and running experiments using a computer model as a virtual test bed. The PD experience focuses on building teachers' content knowledge, pedagogy, developing programming skills and using models to conduct scientific inquiry.

Module 2: Water as a Shared Resource

In this Earth Science, module students will investigate the importance of ground water and the impacts of water usage on aquifer levels, as well as explore how to model important parts of



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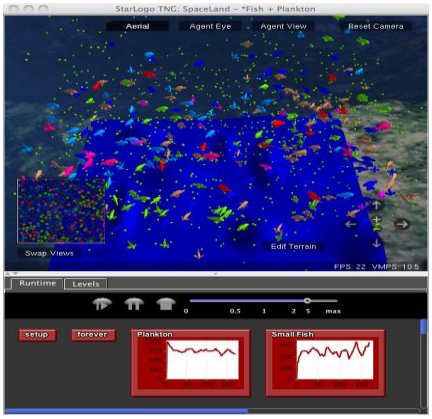
water cycle, including evaporation and infiltration of water into different types of soils to recharge the aquifers.

Module 3: "Ecosystems as complex systems"

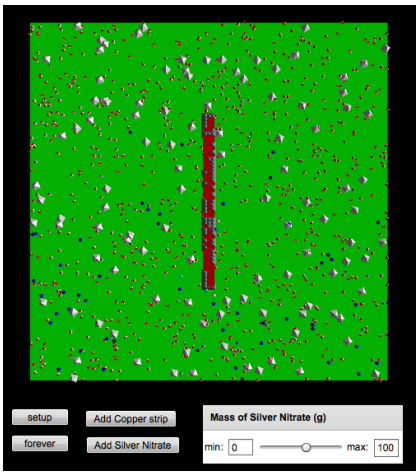


This Life Science module begins with an exploration of a simple predator-prey model to consider who eats whom—and what happens when one population grows faster than another. After learning more about ecosystem dynamics, producers and consumers, and interdependent relationships within an ecosystem, students develop their own model of a local ecosystem.

The primary goal of this unit is to engage students in simple interactive activities to explore ecosystems concepts, and in the use, modification, and creation of an agent-based model of a simple virtual ecosystem.

Module 4: "Chemical Reactions"

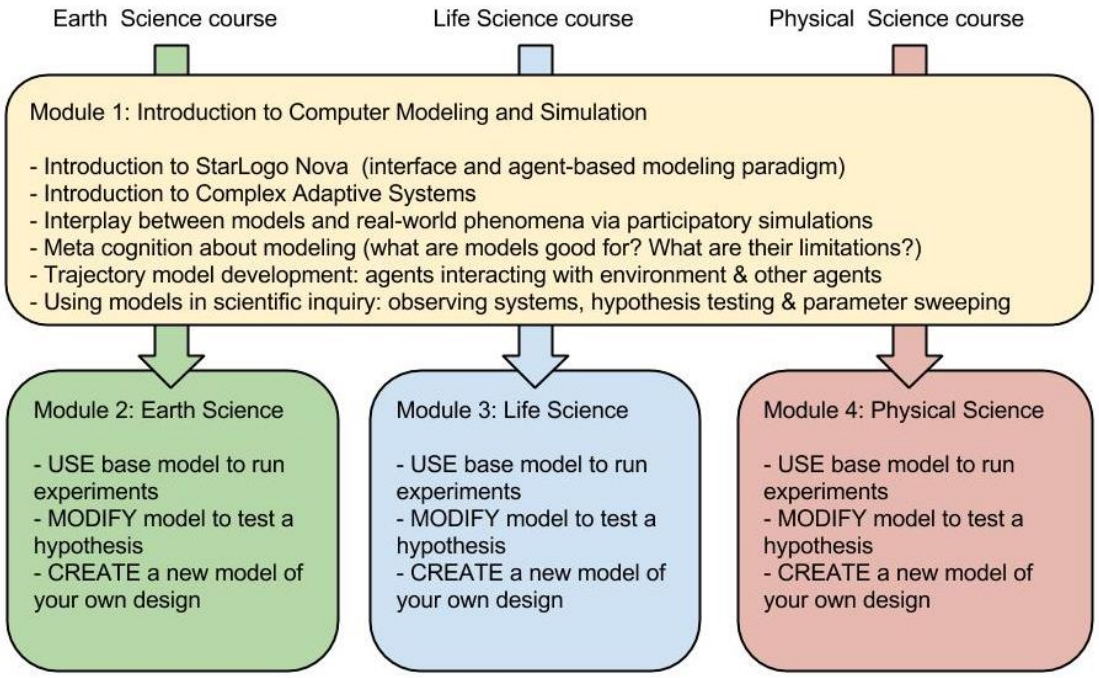
This Physical Science module explores chemical reactions: the conditions under which they occur, the evidence that a chemical reaction has taken place, limiting reactants versus reactants in excess, and when chemical reactions stop. The base model for this unit simulates the chemical reaction between silver nitrate and copper.



After learning about chemical reactions, students run experiments with different amounts of reactants and predict the amount of product formed. They then walk through each part of the model, run experiments to better understand the model, and investigate the factors that impact the rate of a chemical reaction.

Implementing the Code.org Science modules:

Module 1, "Introduction to Computer Modeling and Simulation", can be combined with either Module 2, 3 or 4 to create a ten-day lesson in Earth, Life or Physical Science. Extensions to modules enable them to be used in 6th, 7th or 8th grade.



Throughout the process of computer modeling and simulation, students will follow a "Use-Modify-Create" progression in which they first gain experience with the concepts by using an existing model, then expand on and modify that model, and finally create a model of their own that builds off the knowledge and experience gained in the use and modify phases. This iterative approach to exploring the models facilitates topic mastery while easing students into the technical and programming components of the lessons.

Professional Development Program

Code.org's year-long professional development program prepares middle school science teachers to implement the four modules and support teachers growth as science teachers. Within the PD program teachers are guided through each of the 5-hour instructional sequences; learn basic computer science concepts and computer programming; follow the "Use-Modify-Create" progression while engaging in scientific inquiry; and discuss effective practices and solutions to potential roadblocks.

The program consists of three major components:

Phase 1: Pre-Workshop online preparation. (Spring)

Introductory videos and guided tutorials through which teachers:

- Build background knowledge in Computer Modeling and Simulation
- Progress through a guided tour of StarLogo Nova's interface and capabilities.

Phase 2: Summer intensive professional development workshop. (Summer)

In-person workshops held in which teachers:

- Experience modules as learners in a group setting.
- Learn and practice pedagogy for teaching computer modeling and simulation.
- Design and build simple models the conduct experiments using computer models.
- Walk through subsequent modules in subject area groupings.
- Create a professional learning community that extends throughout the program.

Phase 3: Mini-workshops and online support. (Academic year)

One-day in person mini-workshops held in districts at which teachers:

- Share successes and barriers encountered while implementing modules.
- Practice messaging for students, parents, administrators and others.
- Review best practices for integrating modeling and simulation into STEM classes.
- Learn about additional models for inclusion in disciplinary areas.
- Share best practices for engagement and retention of student interest.
- Online discussions, webinars, and tutorials through which teachers:
- Discuss implementation successes and barriers.
- Assess and share evidence of student learning.
- View video tutorials demonstrating activities that augment and reinforce learning.