Using Scratch to Teach 21st Century Scientific Thinking Skills

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Dec. 9, 2009

21st Century Scientific Thinking

Systems Thinking: Thinking with an awareness of complex causal system
Mechanistic Thinking: Thinking with a mechanical or engineering undertone
Interdisciplinary Thinking: Thinking flexibly across different disciplines
Quantitative Thinking: Thinking with mathematics
Distributed Thinking: Thinking beyond the individual mind to involve other persons or technology

Role of Digital Technology

Three major reasons behind why digital technology should be used to teach 21st century scientific thinking skills:

1) **Situated Learning:** Learning is situated in the same digitally rich culture in which the thinking skills are developed and used by the scientific community
2) **Creative Thinking:** Digital technologies lend well to support creative thinking
3) **Digital Fluency:** Digital fluency is critical in our media-rich participatory culture

New Media Literacy Skills	21st Century Scientific Thinking Skills
Play	Systems Thinking
Performance	Quantitative Thinking
Simulation	Mechanistic Thinking
Appropriation	Mechanistic Thinking
Judgment	Interdisciplinary Thinking
Transmedia Navigation	
Negotiation	
Distributed Cognition	Distributed Thinking
Collective Intelligence	
Multitasking	
Networking	

Scratch Lessons for Mechanistic Thinking

1) Help students understand how modern scientists think mechanistically
2) Have practice thinking mechanistically by simulating how synthetic biologists think in the field
3) Help students recognize mechanistic thinking even when it is not in the context of science, as in their own work via Scratch.

Lesson 1

Familiarize students with Scratch programming language. At this point, Scratch presented simply as medium for creative expression.

Lesson 2

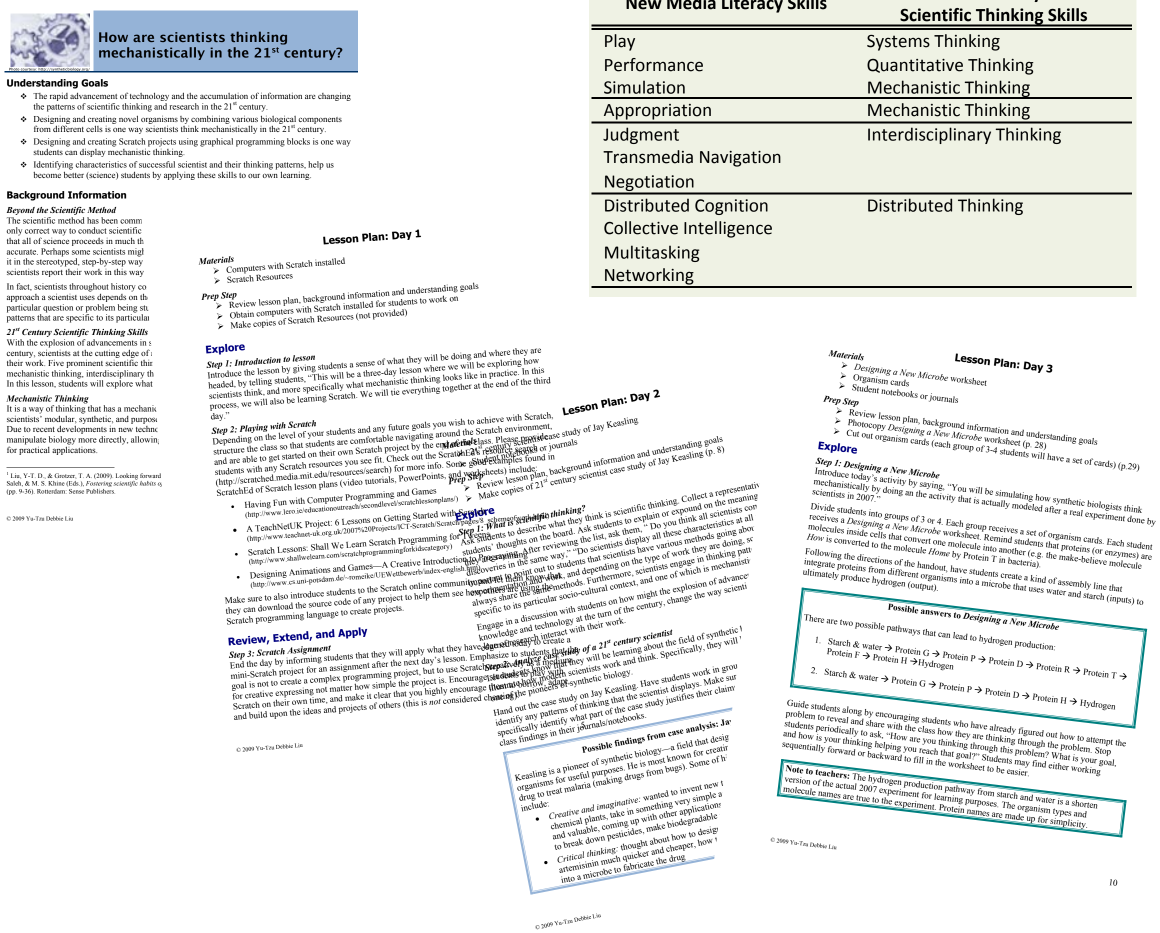
Expose students to creative field of synthetic biology to illustrate how scientists think mechanistically via case study of Jay Keasling, one of the pioneers of synthetic biology. Analyzing how modern scientist work and think provide students with broader view of scientific inquiry.

Ask students to demonstrate their understanding of what they have learned so far by creating a Scratch project.

Lesson 3

Have students practice thinking mechanistically by simulating how synthetic biologists think in the field via activity adapted from actual synthetic biology experiment (designing a microbe that can use starch and water to make hydrogen gas).

Have students reflect on experience with Scratch, and recognize they have been engaging in mechanistic thinking while working on their own Scratch projects. Encourage students to transfer their understanding of mechanistic thinking across different domains. Gain an appreciation of how studying trends in scientists' way of thinking can help students in their own thinking.



MAS.714J / STS.445J Technologies for Creative Learning

Fall 2009