NICE Webinar Series

NATIONAL INITIATIVE FOR CYBERSECURITY EDUCATION

Computational Thinking and Skills: A Foundation for STEM and Cybersecurity Education

March 20, 2019

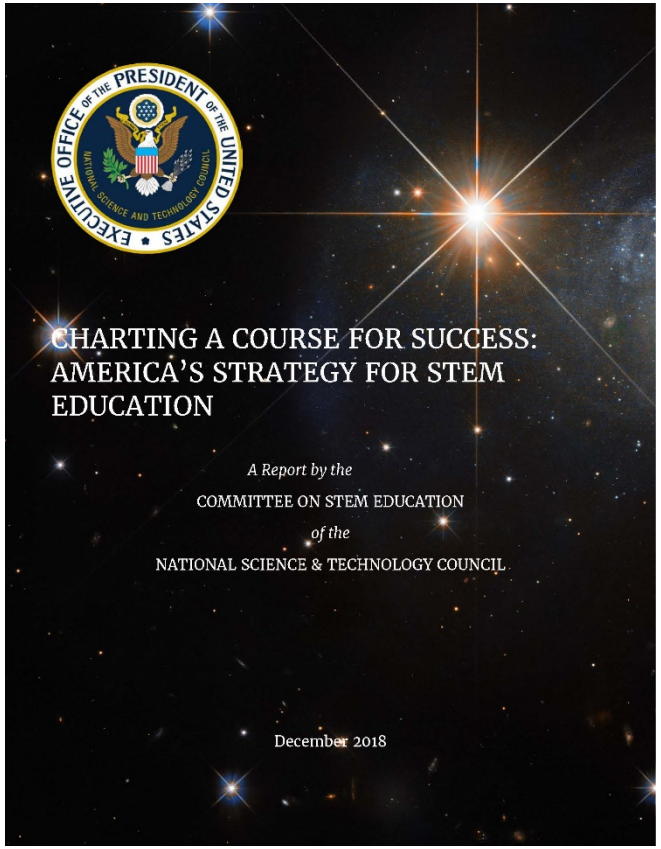
Charting a Course for Success: America's Strategy For STEM Education

December 4, 2018

Why a Federal Strategic Plan for STEM Education?

The 5-year Strategic Plan meets the requirements of Section 101 of the America COMPETES Reauthorization Act of 2010.

Establishing a path to basic STEM literacy for everyone is vital to preparing a diverse workforce needed for the United States to lead and prosper in an increasingly competitive world driven by advanced technology.



https://www.whitehouse.gov/wp-content/uploads/2018/12/STEM-Education-Strategic-Plan-2018.pdf

A Strategy Informed by Stakeholder Input

First-of-its-kind State-Federal STEM Education Summit brought together STEM education specialists from all 50 States.

Input was provided by a Federal advisory committee, comprised of 18 members from academic institutions, nonprofit organizations, and industry, including in-school, out-of-school, and informal education practitioners.

OSTP held over 200 listening sessions with a broad range of stakeholders.

An Interagency Process

The Strategic Plan was developed by the National Science and Technology Council's Committee on STEM Education (CoSTEM) and the White House Office of Science and Technology Policy.

The Federal Coordination in STEM (FC-STEM) subcommittee of CoSTEM and representatives from its member agencies were instrumental in the plan's drafting.

Goals of the Strategic Plan

Plan Vision Statement

All Americans will have lifelong access to high-quality STEM education and the United States will be the global leader in STEM literacy, innovation, and employment.

Build Strong Foundations for STEM Literacy

Prepare the STEM Workforce for the Future

Increase Diversity, Equity, and Inclusion in STEM

Pathways for Success

- Develop and Enrich Strategic Partnerships

Cultivate new or strengthen existing connections between educational entities and the broader communities they serve.

Pathways for Success

➢ Develop and Enrich Strategic Partnerships

Foster STEM ecosystems that unite communities in workforce development.

Increase work-based learning and training through educator-employer partnerships.

Blend successful practices from across the learning landscape.

Pathways for Success

- Engage Students where Disciplines Converge

Teach STEM as an interwoven and complex pursuit that blends disciplines and makes STEM learning meaningful and inspiring.

Pathways for Success

- Engage Students where Disciplines Converge

Advance innovation and entrepreneurship education.

Make mathematics a magnet.

Encourage transdisciplinary learning.

Pathways for Success

- Build Computational Literacy

Ensure that STEM education is heavily imbued with computational skills and accessible through digital means.

Pathways for Success

➢ Build Computational Literacy

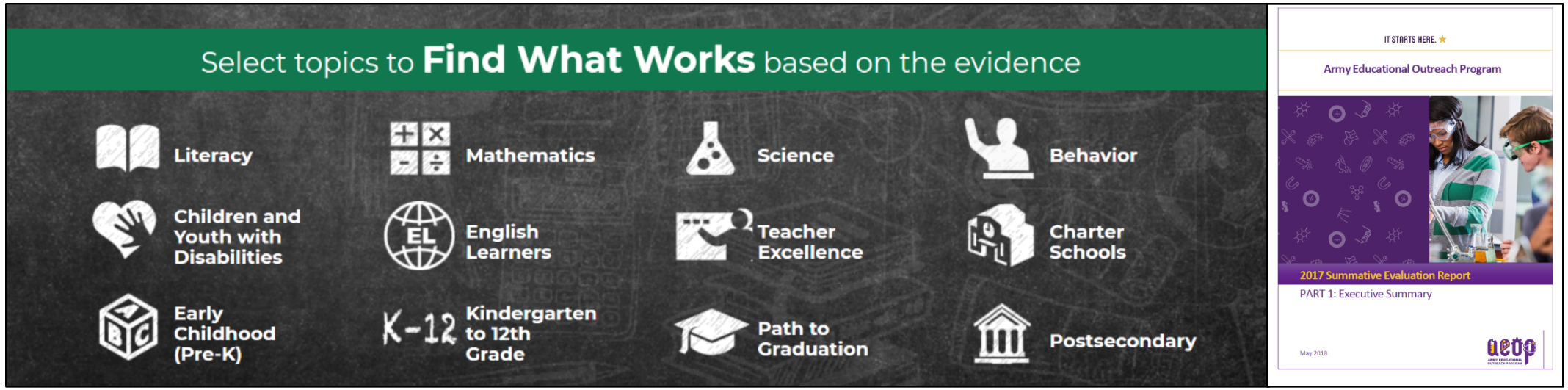
Promote digital literacy and cyber safety.

Make computational thinking an integral element of all education.

Expand digital platforms for teaching and learning.

Pathways for Success

- Operate with Transparency and Accountability



Use evidence-based practices and assessments that can be emulated by other STEM stakeholders.

Pathways for Success

- Operate with Transparency and Accountability

Leverage and scale evidence-based practices across STEM communities.

Report participation rates of underrepresented groups.

Use common metrics to measure progress.

Make program performance and outcomes publically available.

Agency Participation

Pathways	Objectives	DOC	DoD	DOE	DHS	DOI	DOL	DOS	DOT	ED	EPA	HHS	NASA	NSF	SI	USDA
Develop and Enrich Strategic Partnerships	Foster STEM Ecosystems that Unite Communities	●		●	●	●	●	●	●	●	●	●	●	●	●	●
	Increase Work-Based Learning and Training through Educator-Employer Partnerships	●	●	●	●	●	●			●	●	●	●	●	●	●
	Blend Successful Practices from Across the Learning Landscape	●	●	●	●		●	●		●	●			●	●	●
Engage Students where Disciplines Converge	Advance Innovation and Entrepreneurship Education	●		●				●		●	●	●		●		●
	Make Mathematics a Magnet	●	●							●				●		●
	Encourage Transdisciplinary Learning	●	●	●	●	●		●		●	●	●	●	●	●	●
Build Computational Literacy	Promote Digital Literacy and Cyber Safety	●	●		●			●		●		●		●		●
	Make Computational Thinking An Integral Element of All Education	●	●	●	●	●				●		●		●	●	●
	Expand Digital Platforms for Teaching and Learning	●		●	●			●		●				●	●	●

A Nationwide Call to Action

Learners, parents, educators, administrators, educational institutions, government officials, community and professional organizations, public and private sector employers…

The Strategic Plan is a “North Star” – a shared vision of opportunity and excellence for STEM Education.

Aligning to Administration Commitments

- The President established the **National Council for the American Worker** to develop a strategy to ensure American students and workers have access to the training and education they need.
- President Trump signed the reauthorization of the **Carl D. Perkins Career and Technical Education Act** to support career and technical education programs for American students.
- In June 2017, President Trump signed a presidential memorandum directing the **Department of Education** to make STEM and computer science education a top priority and set a goal of devoting at least **$200 million per year toward STEM education**. In FY 2018, the Department spent $279 million in discretionary STEM grants.
- The President signed the **INSPIRE Act** directing NASA to encourage women to study STEM and to pursue aerospace careers.
- President Trump signed legislation enabling the National Science Foundation to better support **women inventors**.

Q & A

Integrating Computational Thinking in STEM Classrooms

Hillary Swanson and Golnaz Arastoopour Irgens

Northwestern University

Why teach Computational Thinking in STEM classrooms?

Authenticity

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Authenticity

• Give learners a more realistic view of what contemporary STEM practices are and what STEM professionals do

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• Better prepare students for pursuing careers in STEM disciplines

CT-STEM

Authenticity

• Give learners a more realistic view of what contemporary STEM practices are and what STEM professionals do

• Better prepare students for pursuing careers in STEM disciplines

• Help equip students to be more science-savvy citizens

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Equity

Equity

- Science and math classes are required

Equity

- Science and math classes are required
- Science and math classes exist

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Equity

- Science and math classes are required
- Science and math classes exist
- Science and math teachers exist

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Pedagogy

Pedagogy

- Computational tools support deep science and math learning

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Pedagogy

- Computational tools support deep science and math learning

- Science and math provide meaningful contexts for teaching computational thinking practices

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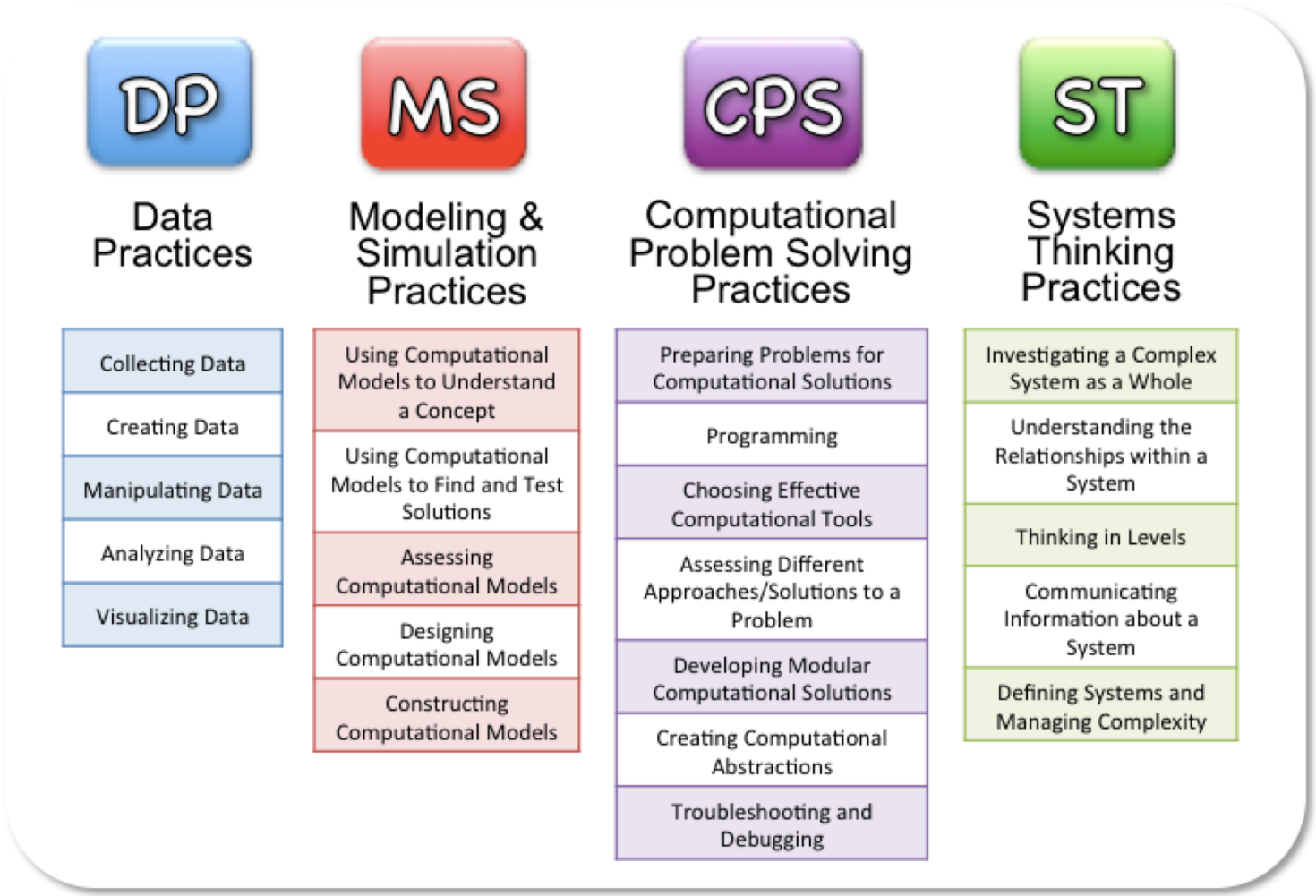
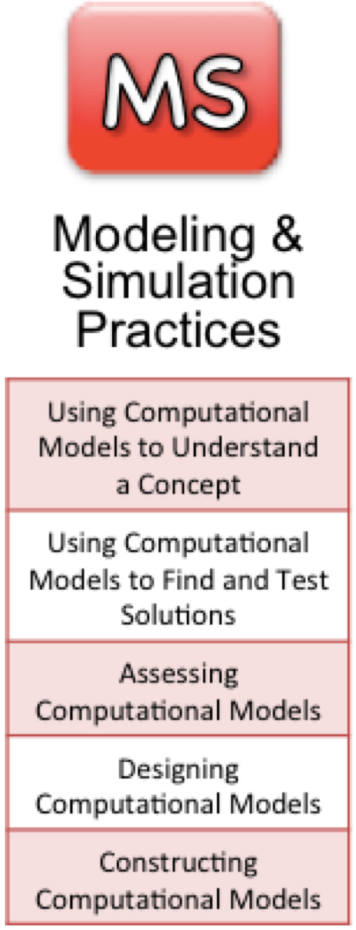
How do we characterize Computational Thinking in STEM?

Computational Thinking in STEM Taxonomy



(Weintrop et al., 2016)

CT-STEM Learning Objectives



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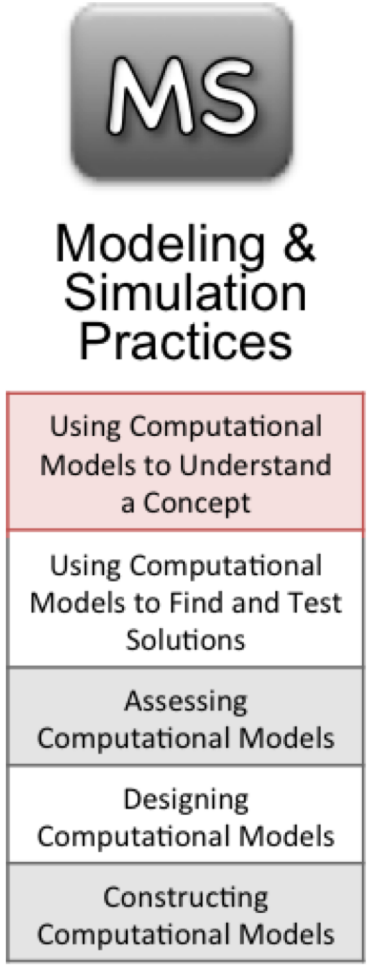

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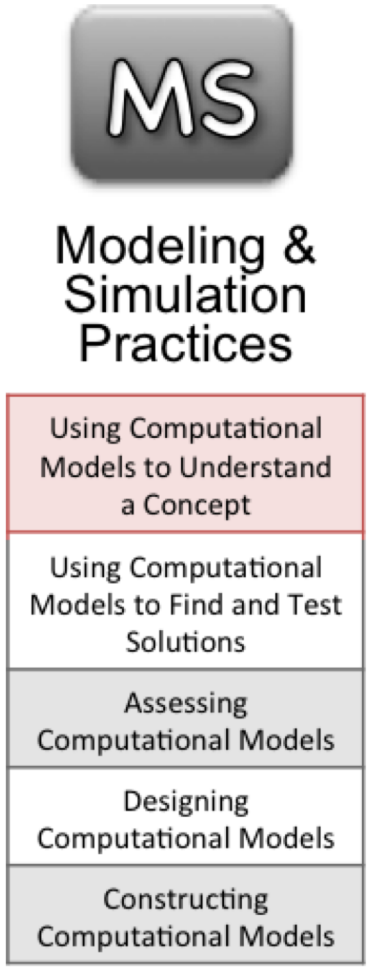
CT-STEM Learning Objectives

- Exploring a model by changing parameters in the interface or code



CT-STEM

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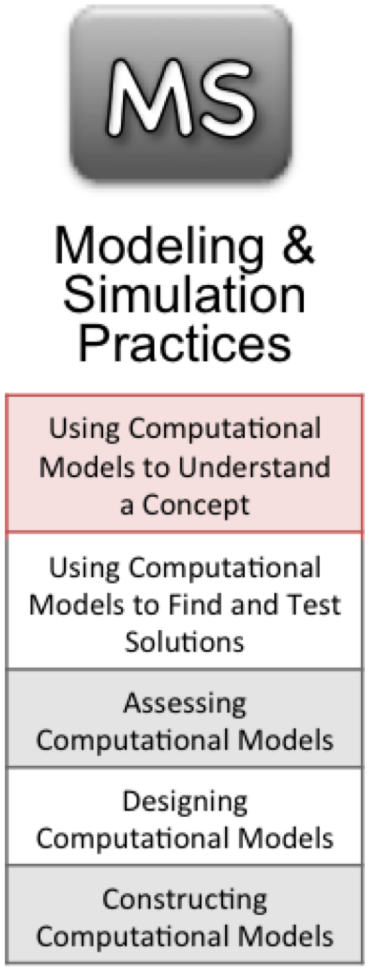
- Exploring a model by changing parameters in the interface or code
- Explaining the phenomenon represented by a model



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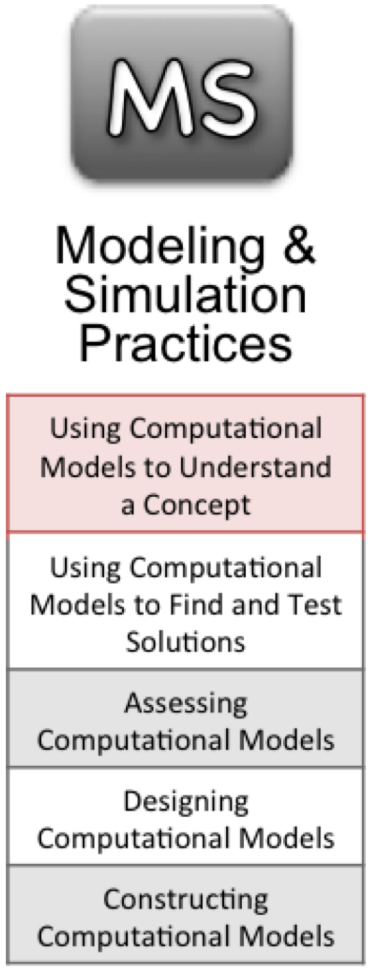

- Using a model as evidence to support an argument

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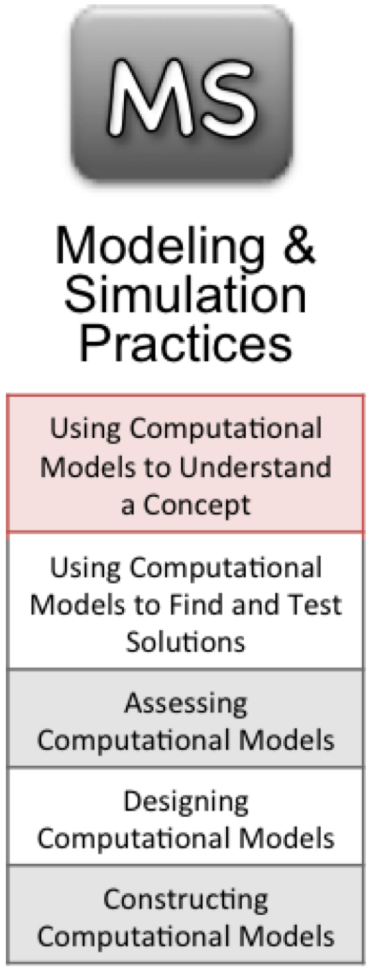

- Using a model as evidence to support an argument
- Understanding how models can be used to understand a concept or test a hypothesis

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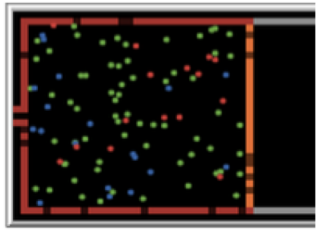
Curriculum

CT-STEM | Teaching Resources | Intro to CT | Training | About | Register | Login



Connected Chemistry Unit 1: Gas Laws - v3.

Subject(s): Chemistry

Standards:
- Next Generation Science Standards
- Computational Thinking in STEM

Author(s): Aimee Moses, Gabriella Anton, Umit Aslan

Lessons: 4

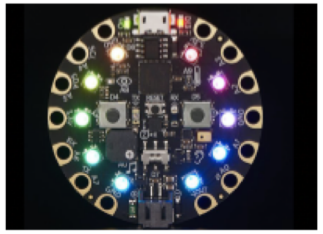
Ecosystems: Interactions, Energy, and Dynamics - v10.

Subject(s): Biology

Standards:
- Next Generation Science Standards
- Computational Thinking in STEM

Author(s): Sugat Dabholkar

Lessons: 1



Electrons to Electricity - How does a Circuit Work? - v1.

Subject(s): Physics

Standards:
- Next Generation Science Standards
- Computational Thinking in STEM

Author(s): Melissa Beemsterboer

Lessons: 10

(Dabholkar, 2018)

Question 4.2

Explain how plants **indirectly** affect the population of wolves. Use the simulation to help explain your claim.

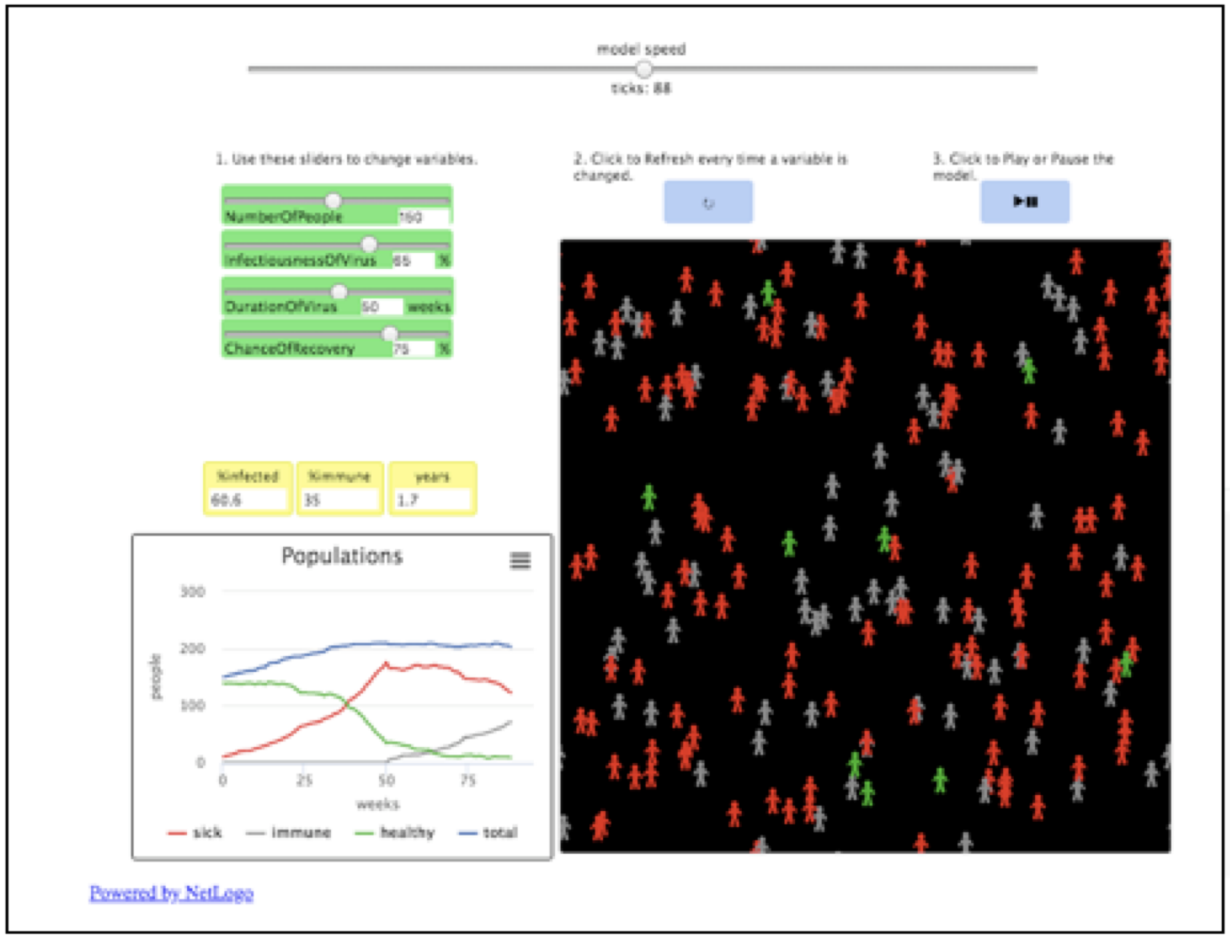
if there are no plants the moose would not eat so moose would die out and wolfs wont have food to eat.

Question 4.4

Would you describe this ecosystem as stable or unstable? Support your choice.

stable, the wolves and moose are in a stable way that the moose or the wolves won't be extinct for some time.

Pre/Post Assessment



Question 6.2

You just received information about and modeled two real-world viruses, HIV and Ebola, but models don't always perfectly reflect the real world. List at least two ways that this model makes simplifications compared to how these viruses and other related factors behave in the real world.

Question 6.3

Given these simplifications and your understanding of the model, why and how is this model useful for the study of viruses?

(Arastoopour Irgens, 2017)

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Research Findings

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- Students developed competencies for CT-STEM practices as a result of engaging in our curriculum (Swanson et al., 2017)
- Our performance-based pre/post assessments measured students' CT-STEM practices (Arastoopour Irgens et al., 2019)
- A combination of pre/post and embedded assessments revealed developmental trajectories of students' CT-STEM practices (Arastoopour Irgens et al., 2019)

CT-STEM

https://ct-stem.northwestern.edu

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Q & A

Thank You for Joining Us!

Upcoming Webinar: "Women in Cybersecurity: Finding, Attracting and Cultivating Talent"

When: Wednesday, April 17, 2019 at 2:00pm EDT

Register: https://nist-nice.adobeconnect.com/webinar-apr2019/event/registration.html

nist.gov/nice/webinars

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