

AND NOW FOR
SOMETHING
COMPLETELY
DIFFERENT





We don't need AI in science education;
we need science education *for* AI

Exploring System Dynamics in the Natural World with AI

30 Sep 2024

Danny Caballero (he/they)

Department of Physics and Astronomy

CREATE For STEM Institute



We don't need AI in science education;
we need science education *for* AI
research

Exploring System Dynamics in the Natural World with AI

30 Sep 2024

Danny Caballero (he/they)

Department of Physics and Astronomy

Department of Computational Mathematics, Science, and Engineering

CREATE For STEM Institute



Who invited this science educator to my AI conference?

Blame John

- Professor of Physics and Computational Science
- Co-direct two research labs (in Physics & Computational Science Education)
- PhD in Physics from Georgia Tech; Postdoc Physics Education at CU-Boulder
- Former high school physics teacher; Atlanta Public Schools
- Current Labor Organizer for Union of Tenure System Faculty
- Taught at MSU for 12 years.





Danny Caballero
github.com/dannycab

13 followers • 2 following
Michigan State University • East Lansing, MI
@physicistdanny



Why do I think John invited me?

Not just to catch up...

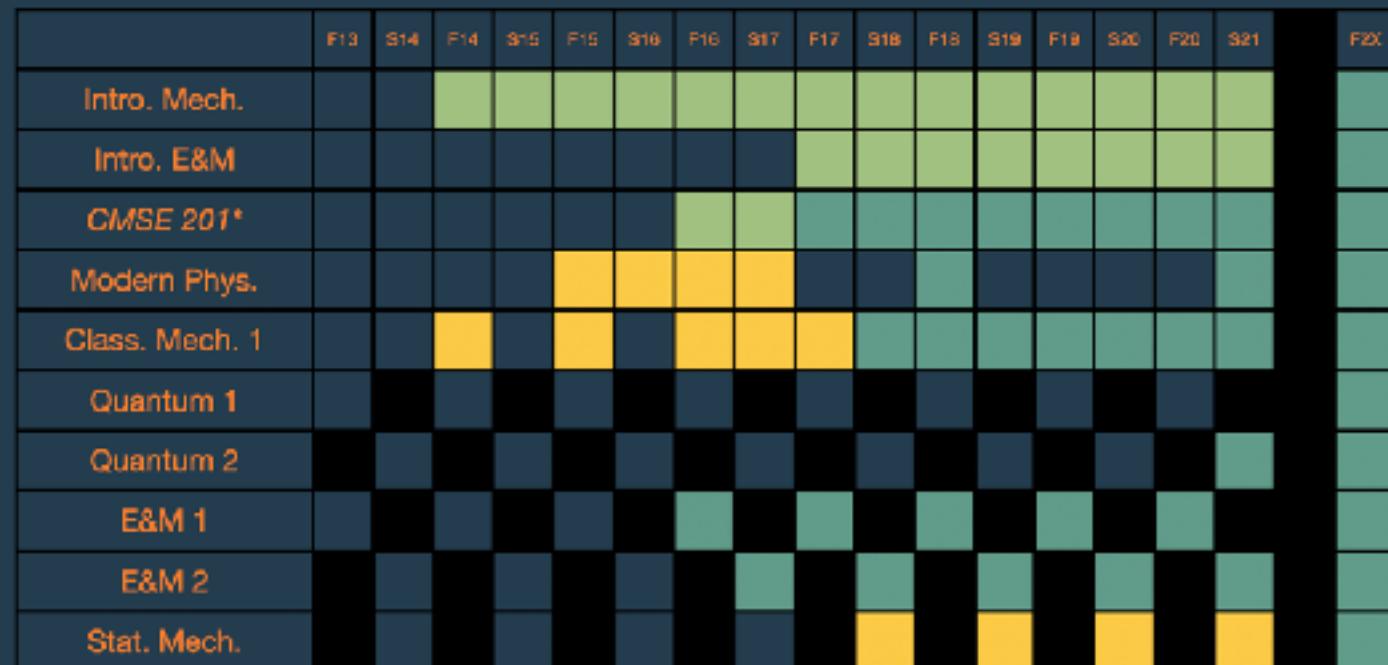


3 research efforts in science education

I like helping people think about and solve big problems in science education



decade-long national effort to integrate computing into physics



computing across the physics program at MSU and in area high schools

Why do I think John invited me?

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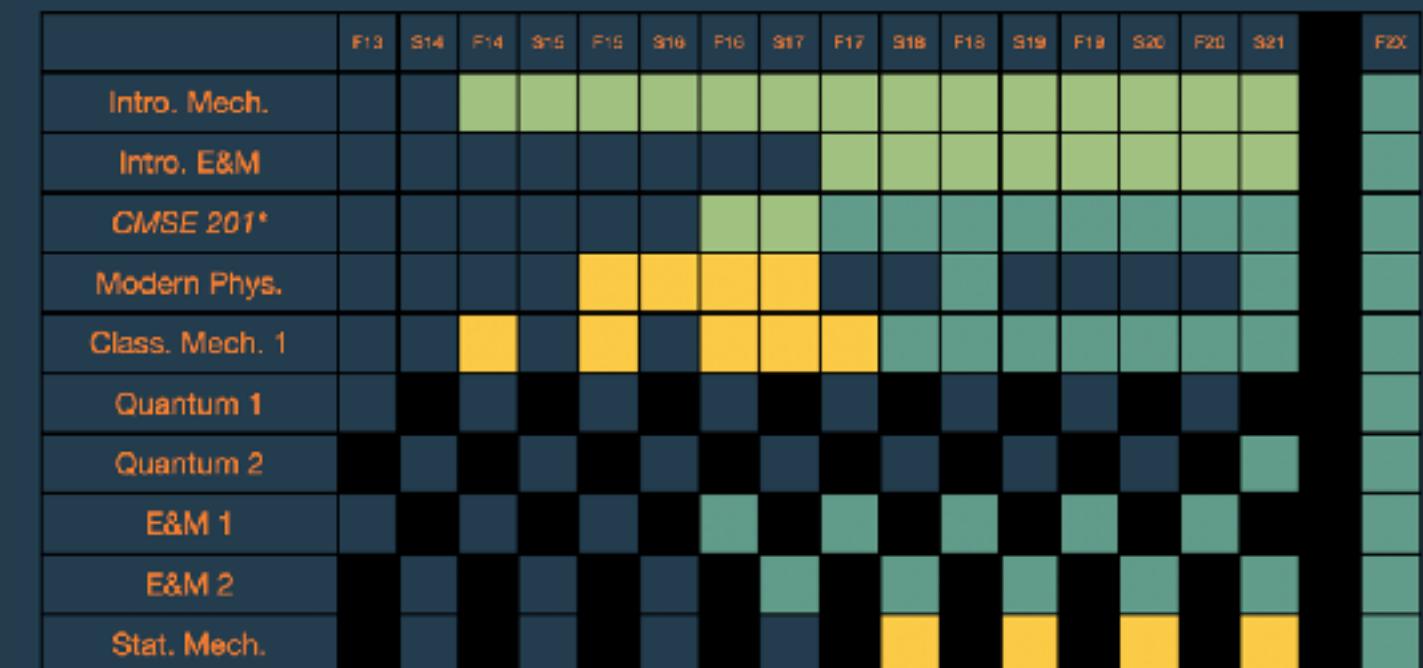
3 research efforts in science education



decade-long national effort to integrate computing into physics

Big problem?

What is the relationship between education in science and artificial intelligence?



computing across the physics program at MSU and in area high schools

This is not a presentation of the ways we can or should use AI in education; it's framing the issue.

Artificial Intelligence has “arrived”

And it will “disrupt” education

● January 05, 2024

How Will AI Disrupt Higher Education in 2024?

Last year was when generative AI infused higher education. What can we expect in this new year?

No. 10 | 2024

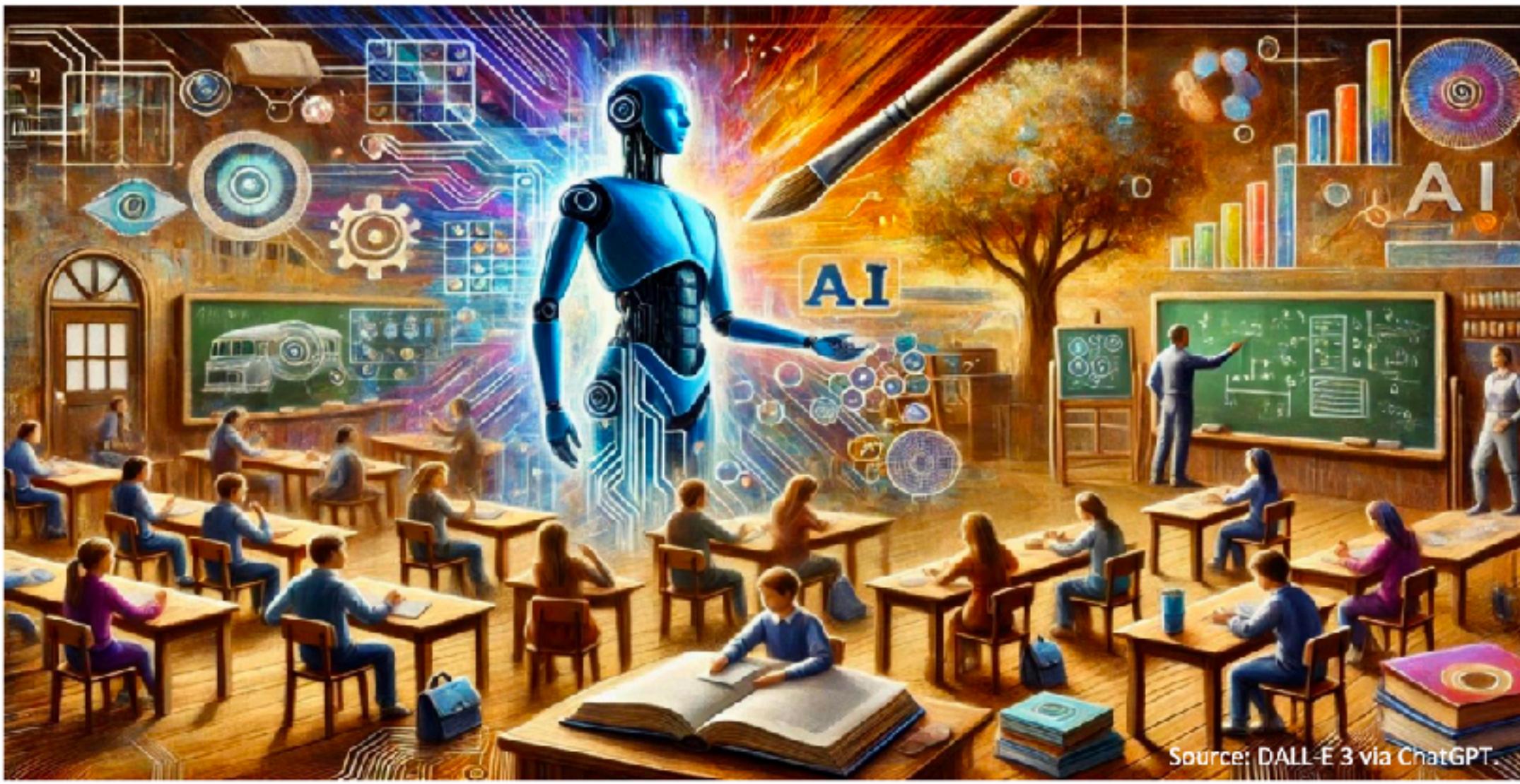
By Ray Schroeder

13 August 2024

AI is Disrupting Education – For Better or Worse

Challenges and Strategies for Sustainable Learning and Institutional Resilience

Anselm Küsters



Source: DALL-E 3 via ChatGPT.

Forbes

FORBES > LEADERSHIP > LEADERSHIP STRATEGY

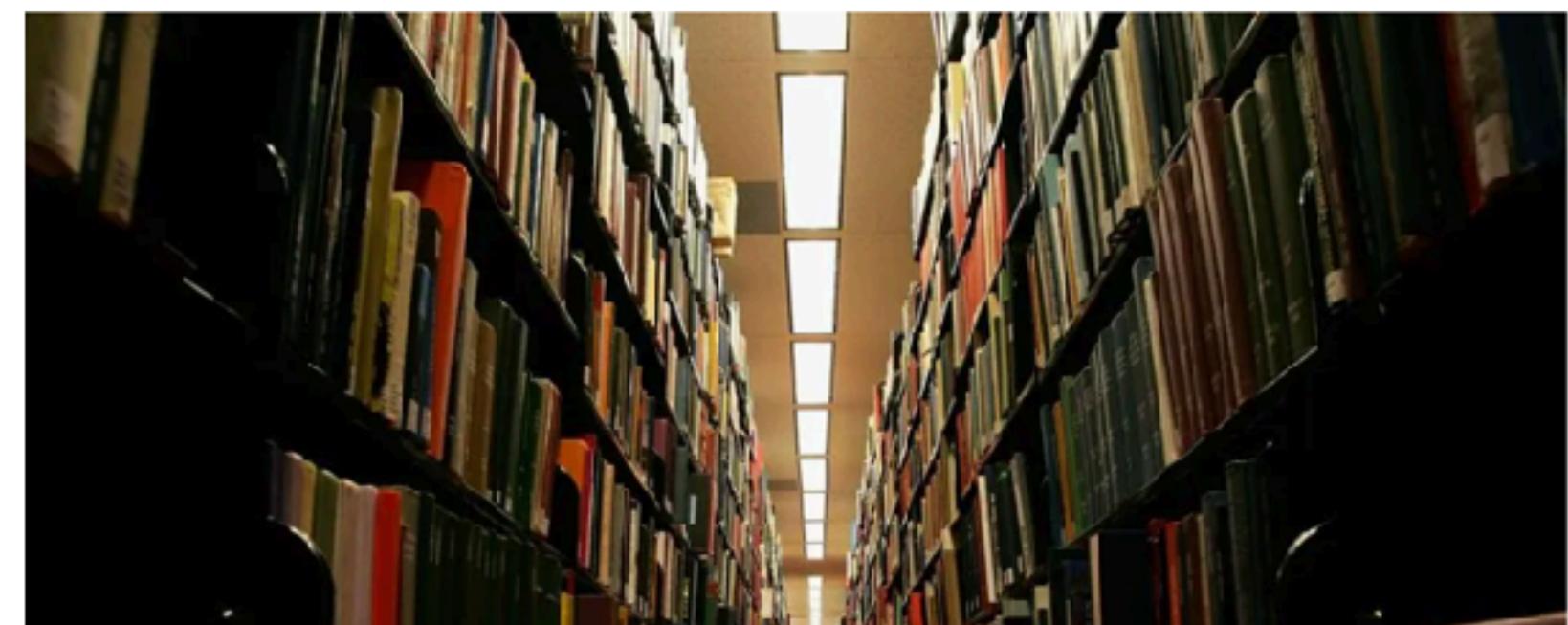
The Future Of Education - Disruption Caused By AI And ChatGPT: Artificial Intelligence Series 3/5

Nicole Serena Silver Contributor ©
Nicole Serena Silver covers entrepreneurship and the future of work.

Follow

Jun 5, 2023, 09:25pm EDT

Updated Jun 20, 2023, 01:29am EDT



What is being discussed?

AI has several potential benefits

Benefits

- Personalized Learning
- Supporting Educators & Reducing Administrative Burden
- Enhancing Student Engagement
- Improving Learning Analytics
- Expanding Access to Education
- Supporting Students with Different Needs
- Enhanced Collaboration & Communication

What is being discussed?

AI has several potential benefits & numerous concerns:

Benefits

- Personalized Learning
- Supporting Educators & Reducing Administrative Burden
- Enhancing Student Engagement
- Improving Learning Analytics
- Expanding Access to Education
- Supporting Students with Different Needs
- Enhanced Collaboration & Communication

Concerns

- Algorithmic Bias & Automating Inequality
- Dehumanization of Education
- Threats to Academic Integrity
- Data Privacy & Security
- Deprofessionalization of Teaching & Job Losses
- Over-reliance on Technology
- Ethics Issues & Lack of Transparency

Framing the AI issue

Three frames

- Technological Solutionism:
tech can provide the necessary
solutions
- dealing with issues of scale
 - addressing funding & efficiency
 - emphasize personalization
 - take advantage of new tech

*Sal Khan, Clayton Christensen,
Sugata Mitra, Eric Hanushek,
Michelle Rhee, Daphne Koller,
Sebastian Thrun*

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Human-centered Education:
social relationships are
paramount

- emphasize critical thinking
- leverage experiential learning
- promote socioemotional
development
- center humans in tech

*John Dewey, Nel Noddings,
Seymour Papert, Andrea DiSessa,
Pasi Sahlberg*

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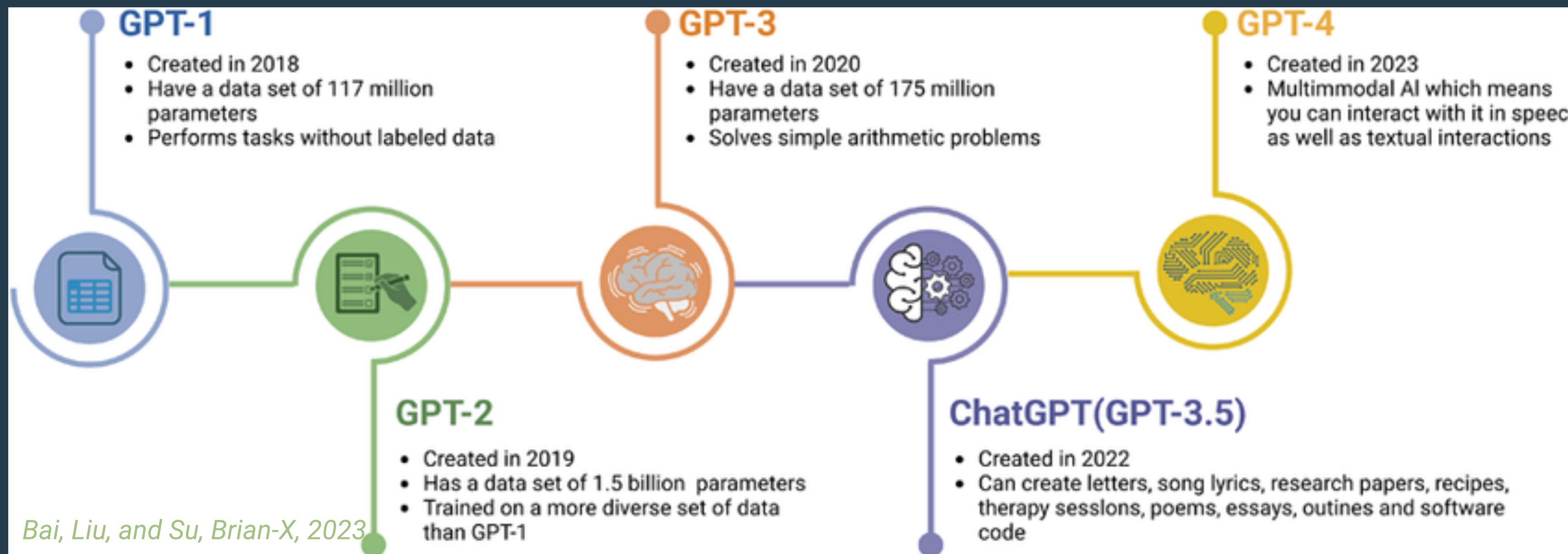
Education as a tool for Justice
education is a political act of
liberation

- promote diversity & equity
- emphasize social justice and
liberation
- educational systems
perpetuate inequality

*Paulo Freire, bell hooks,
Henry Giroux, Ruha Benjamin,
Gloria Ladson-Billings,
Angela Valenzuela*

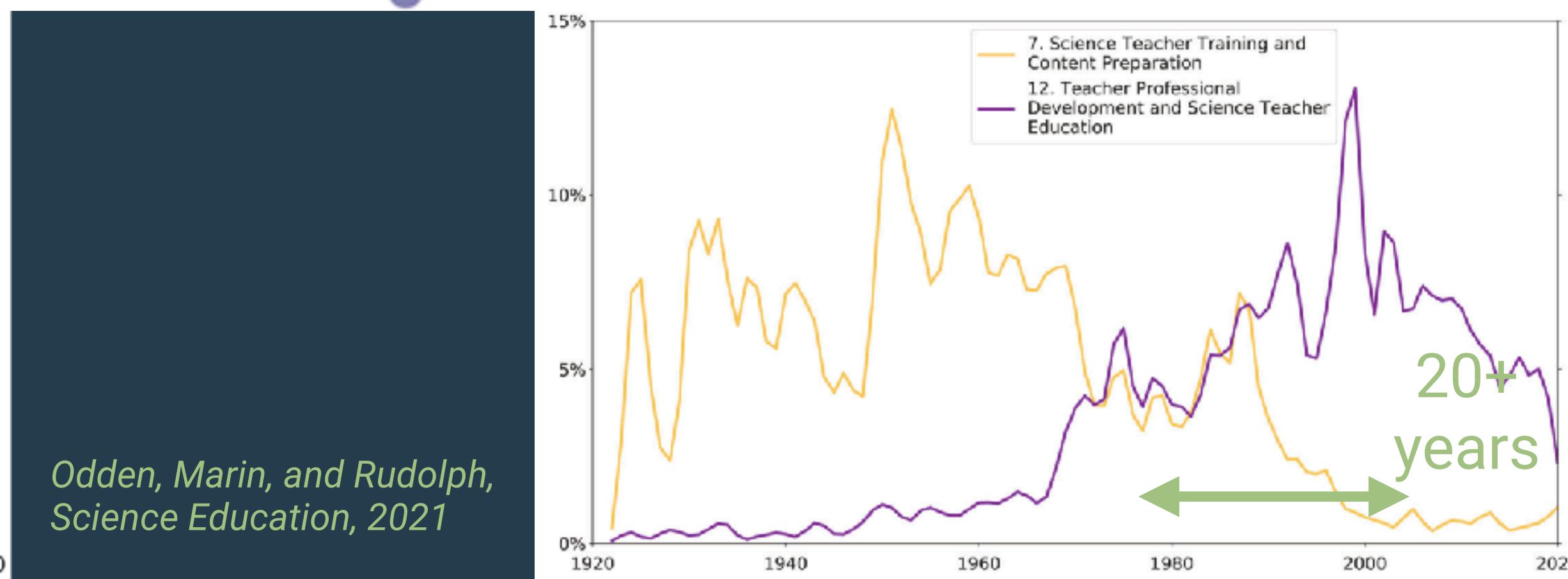
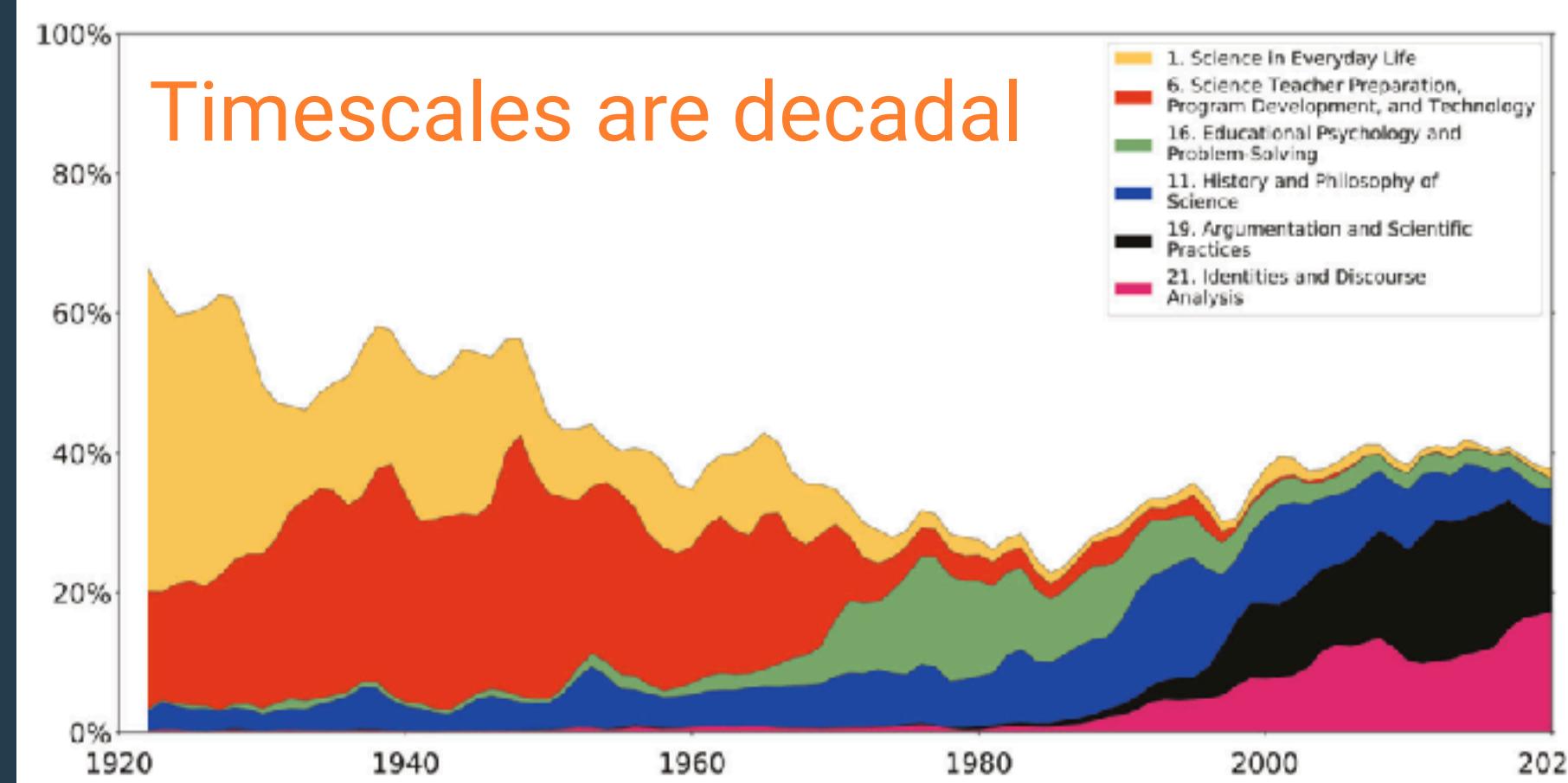
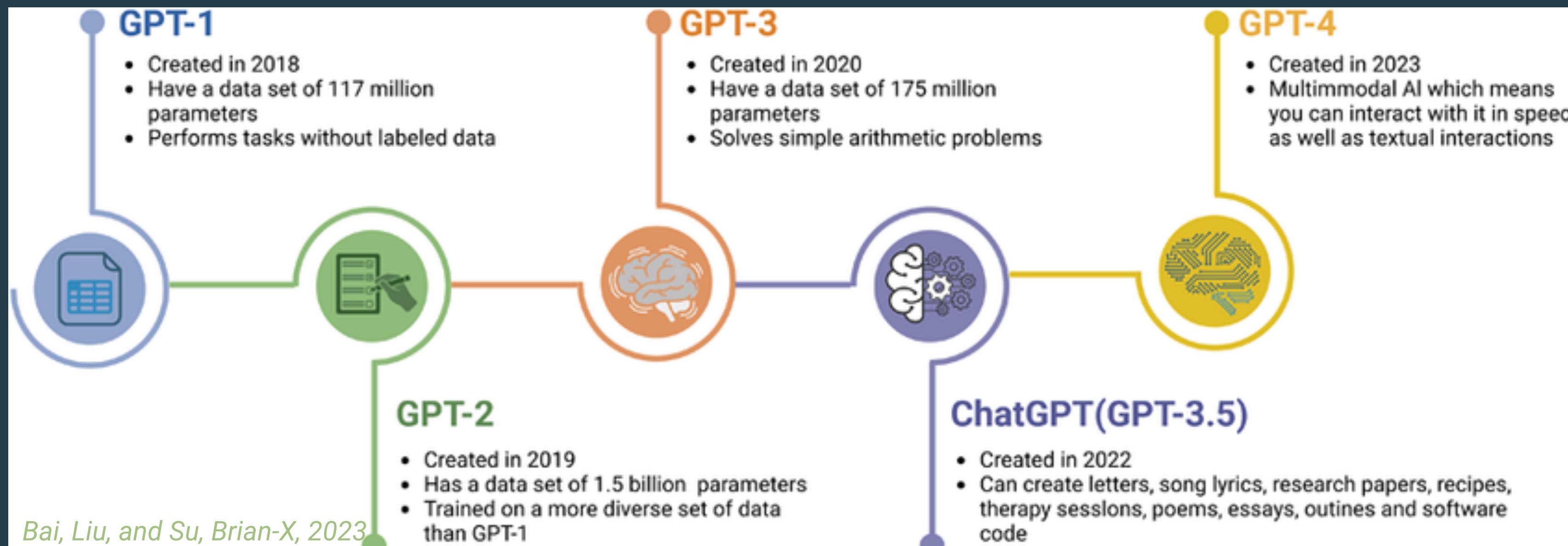
Rapid development

Development is too rapid for education research capacity and pace



Rapid development

Development is too rapid for education research capacity and pace



K-5



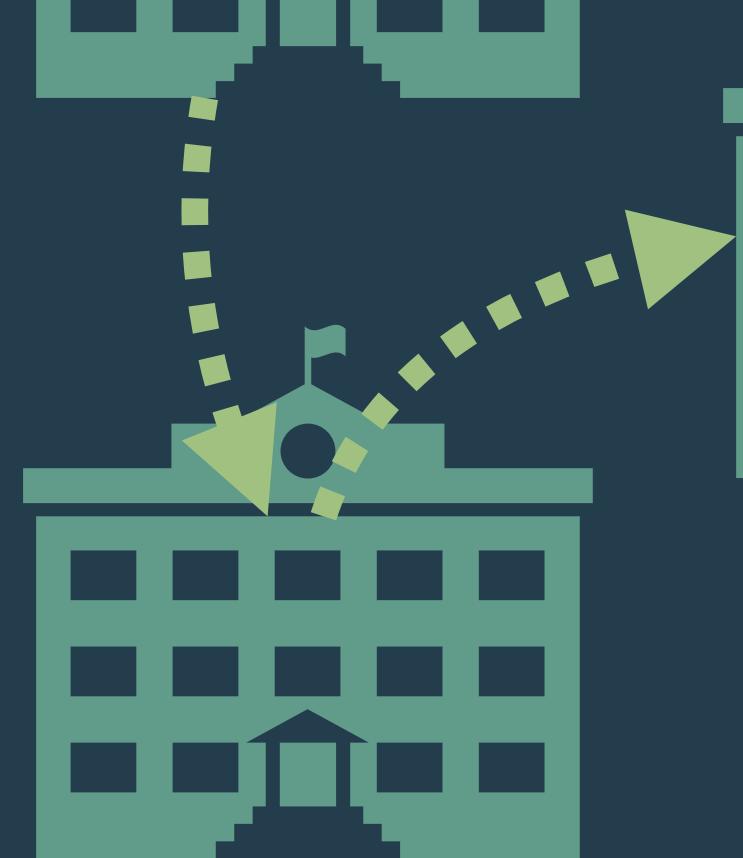
6-8



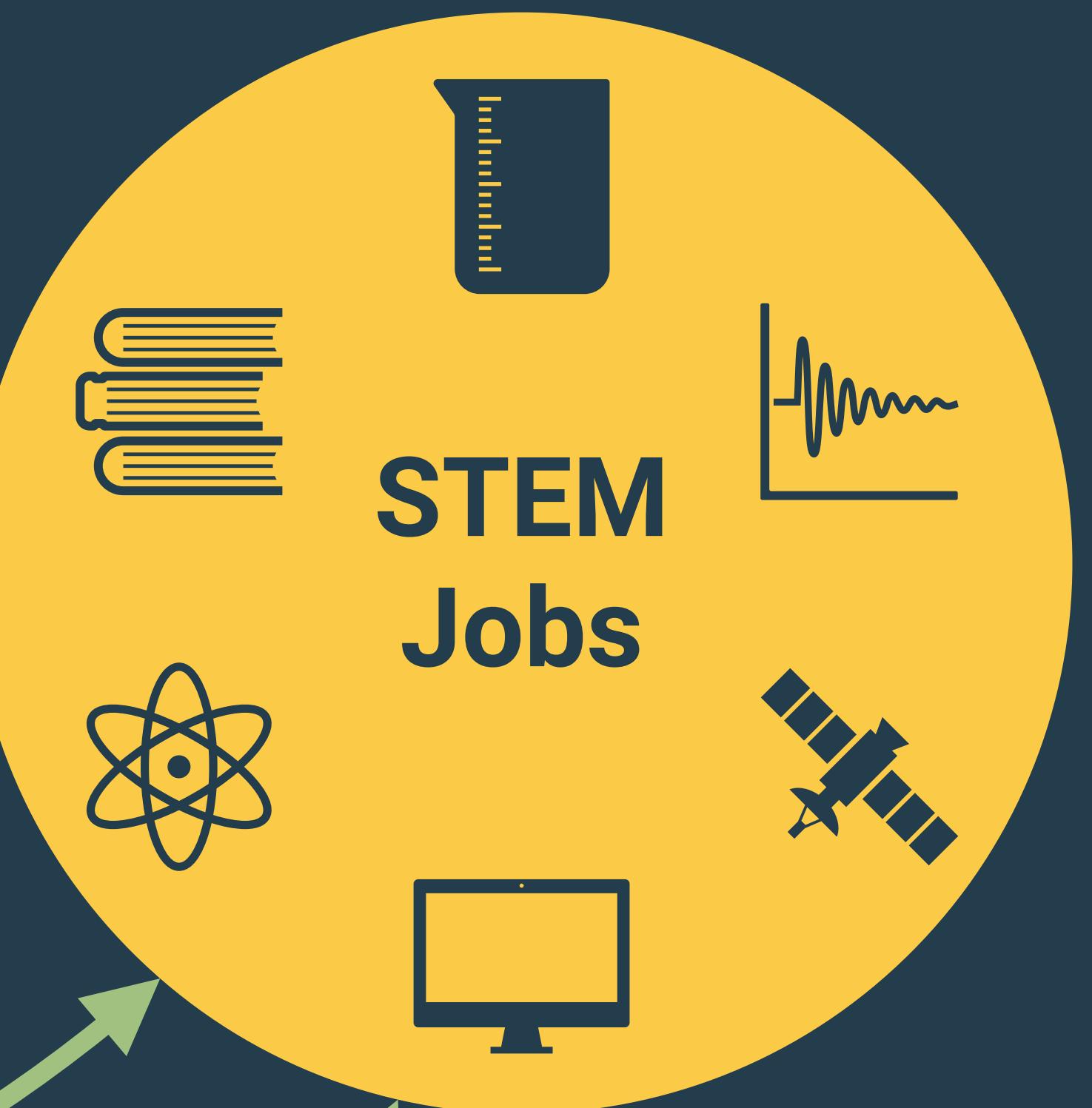
9-12



Uni.

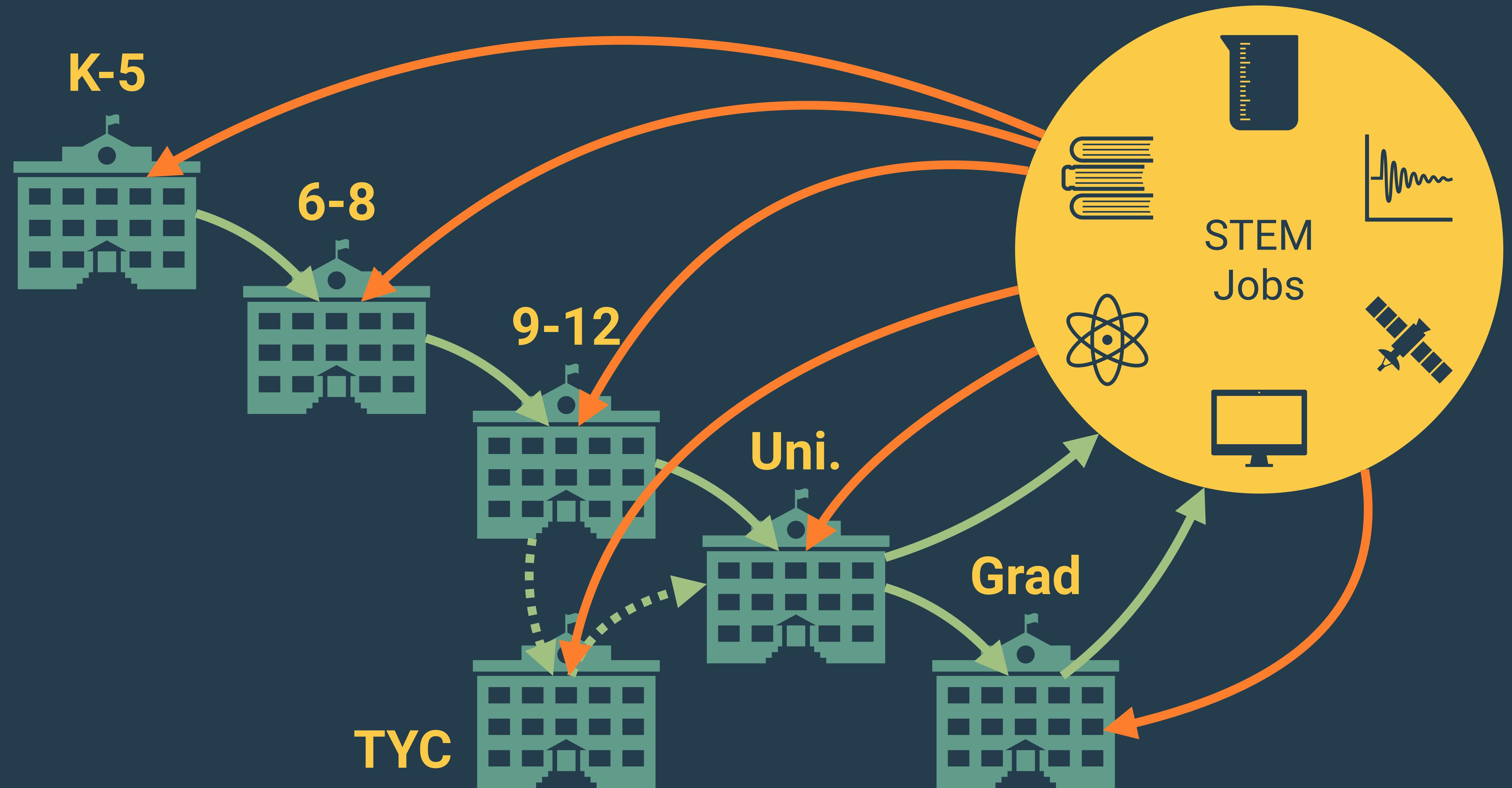


TYC

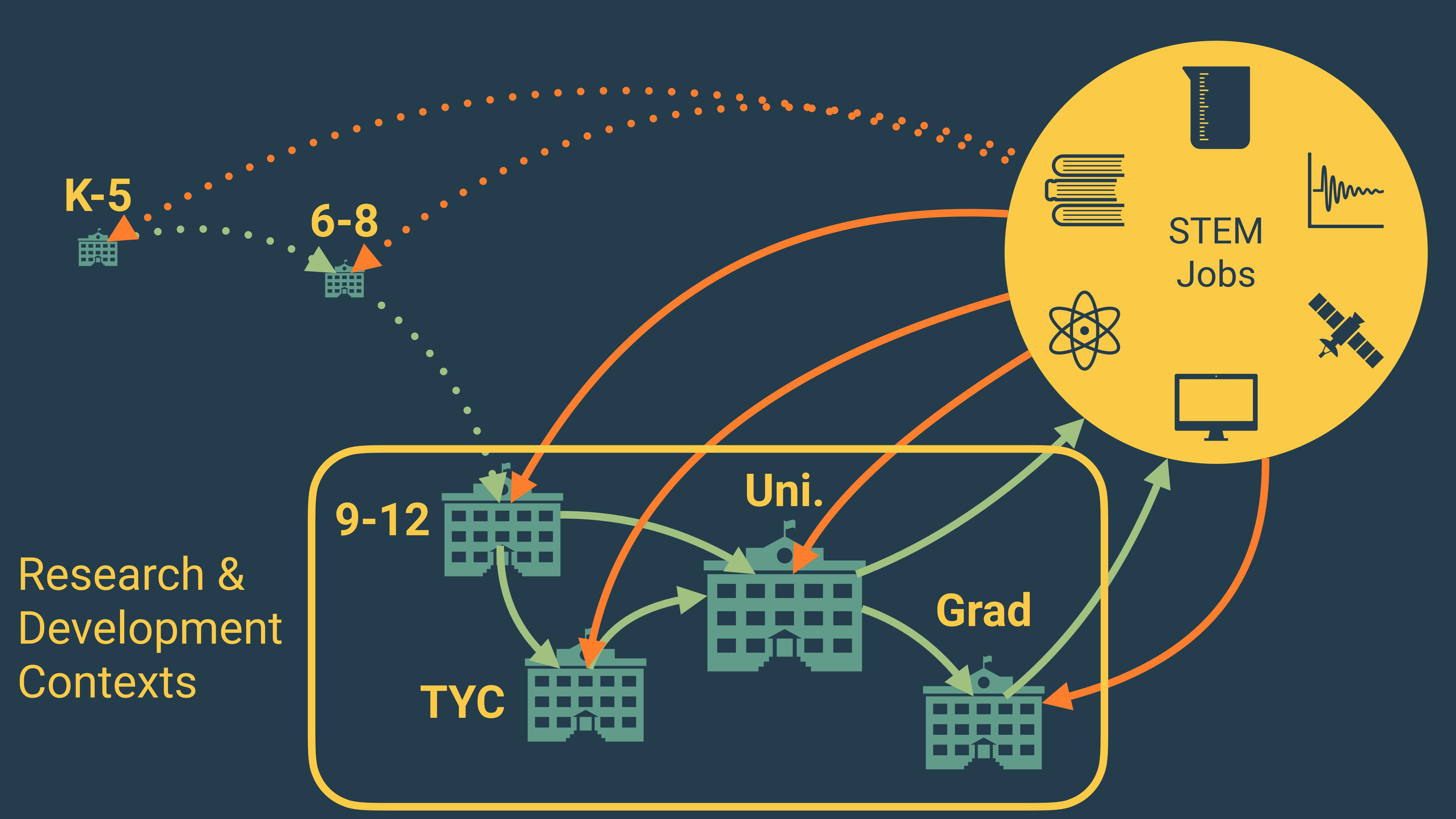


Grad



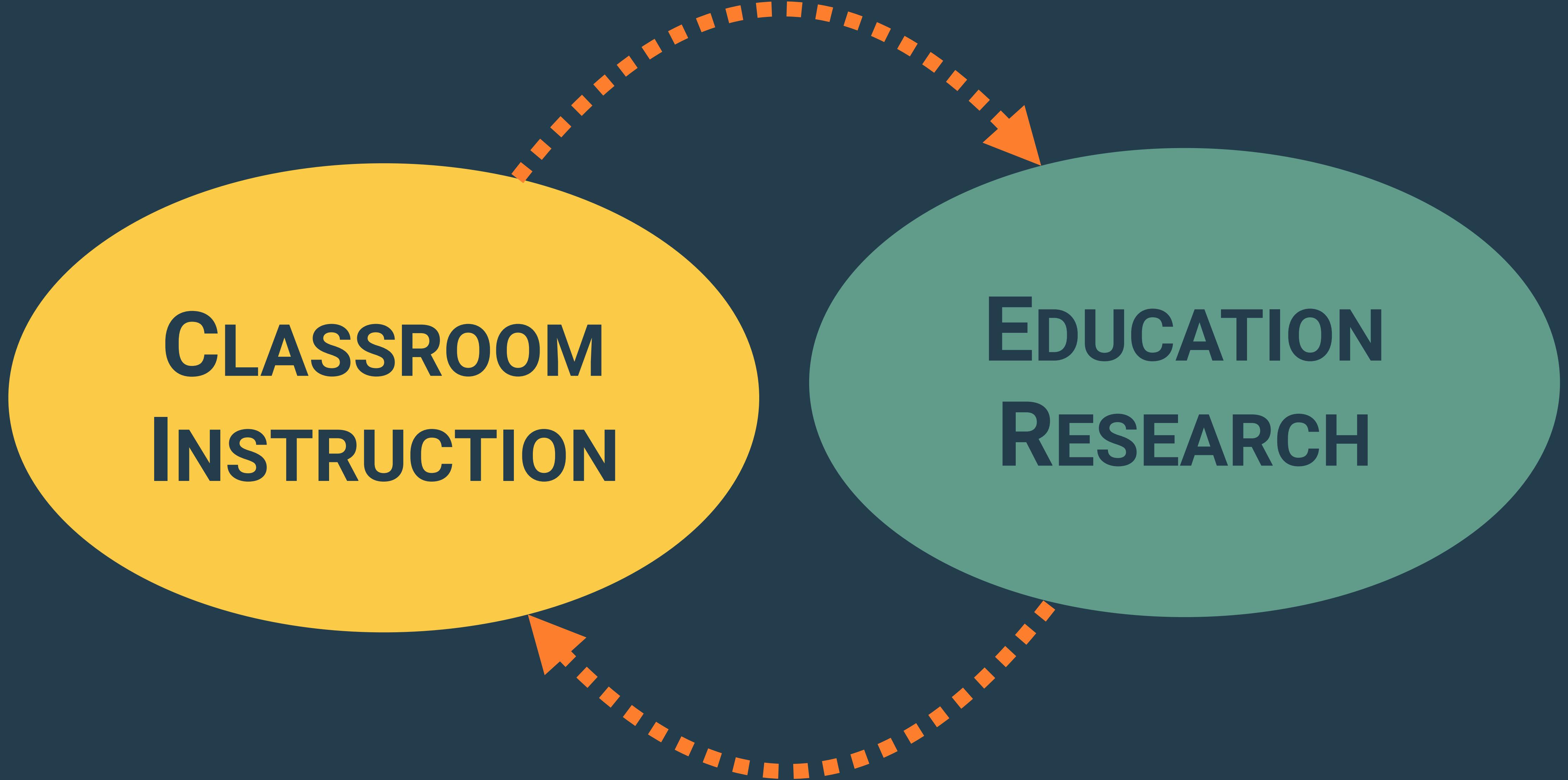


There's feedback in the system



What is the relationship between education in science and artificial intelligence?



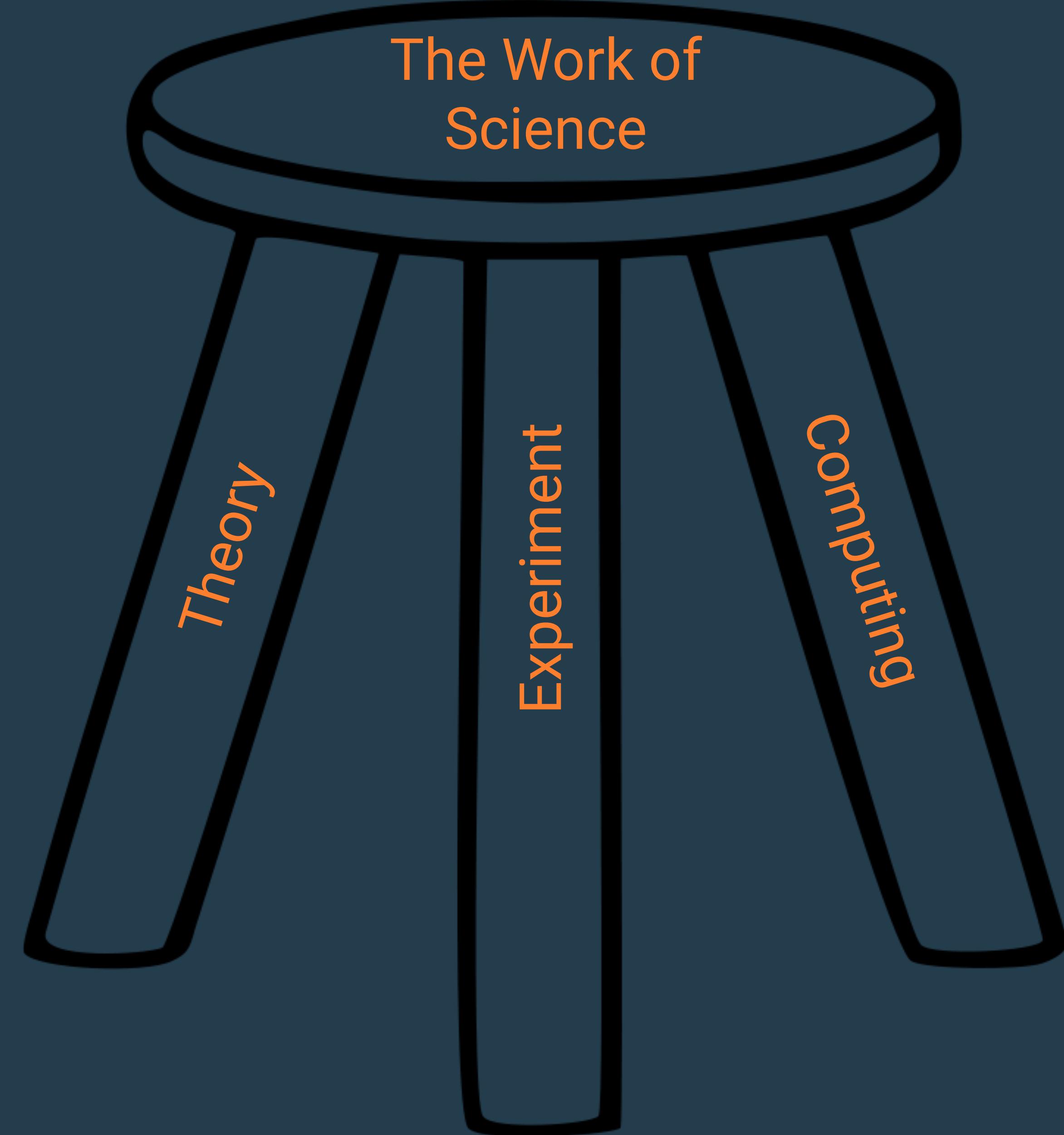


**CLASSROOM
INSTRUCTION**

**EDUCATION
RESEARCH**

Let's use the integration of computing in physics courses as a model of change.

Computing is how science is done.





Computing in physics is:

PHYSICAL REVIEW SPECIAL TOPICS - PHYSICS EDUCATION RESEARCH 8, 020106 (2012)

Implementing and assessing computational modeling in introductory mechanics

Marcos D. Caballero,^{1,*} Matthew A. Kohlmyer,^{2,†} and Michael F. Schatz^{1,‡}

¹*Center for Nonlinear Science and School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332, USA*

²*Department of Physics, North Carolina State University, Raleigh, North Carolina 27695, USA*

(Received 26 July 2011; published 14 August 2012)

```
1 from __future__ import division
2 from visual import *
3
4 craft = sphere(pos = vector(10e7,0,0), color = color.white, radius = 1e6)
5 Earth = sphere(pos = vector(0,0,0), color = color.blue, radius = 6.3e6)
6 trail = curve(color = craft.color)
7
8 G = 6.67e-11
9 mcraft = 1500
10 mEarth = 5.97e24
11
12 vcraft = vector(0,2400,0)
13 pcraft = mcraft*vcraft
14
15 t = 0
16 deltat = 60
17 tf = 365*24*60*60
18
19 while t < tf:
20
21     r = craft.pos-Earth.pos
22     rhat = r/mag(r)
23     Fgrav = -G*mEarth*mcraft/mag(r)**2*rhat
24
25     pcraft = pcraft+Fgrav*deltat
26     craft.pos = craft.pos + pcraft/mcraft*deltat
27
28     trail.append(pos = craft.pos)
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31 print 'Craft final position: ', craft.pos, 'meters.'
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Initial Conditions

Force Calculation

Newton's Second Law

Position Update



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Using the computer as a tool to model, to simulate, and / or to visualize a physical problem.

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Train students to solve physics problems with python

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Categorize mistakes

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PHYSICAL REVIEW SPECIAL TOPICS - PHYSICS EDUCATION RESEARCH 8, 024106 (2012)

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2012

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Physics computational literacy: An exploratory case study using computational essays

Tor Ole B. Odden¹, Elise Lockwood², and Marcos D. Caballero^{1,3}

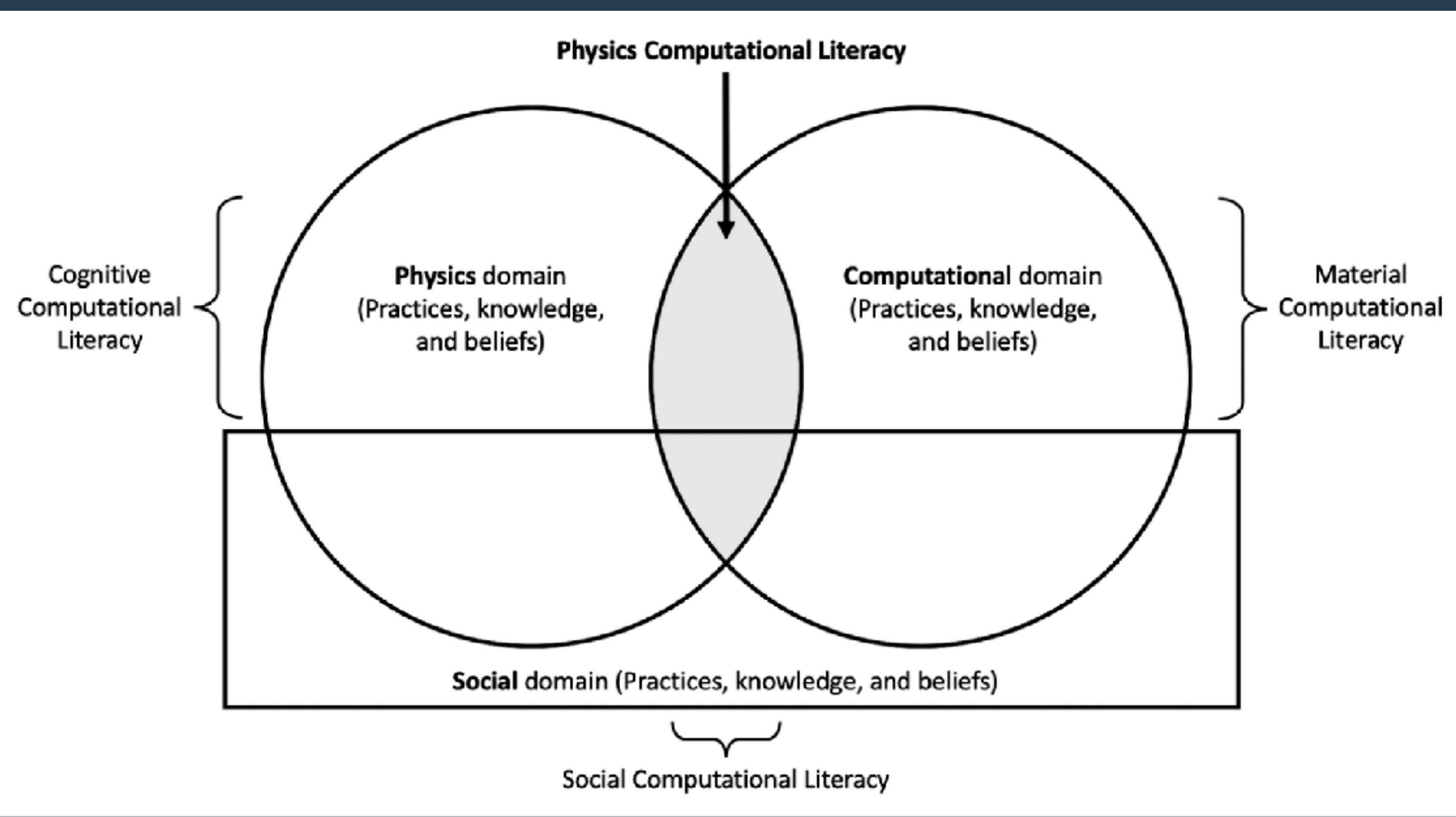
¹*Center for Computing in Science Education, University of Oslo, 0316 Oslo, Norway*

²*Department of Mathematics, Oregon State University, Corvallis, 97331 Oregon, USA*

³*Department of Physics and Astronomy & CREATE for STEM Institute, Michigan State University, East Lansing, 48824 Michigan, USA*



The Research Council
of Norway



Computational Literacy
involves cognitive, material,
and social literacies

Overlapping practices,
knowledge, and
beliefs

Requires further R&D

How Physics Students Develop Disciplinary Computational Literacy

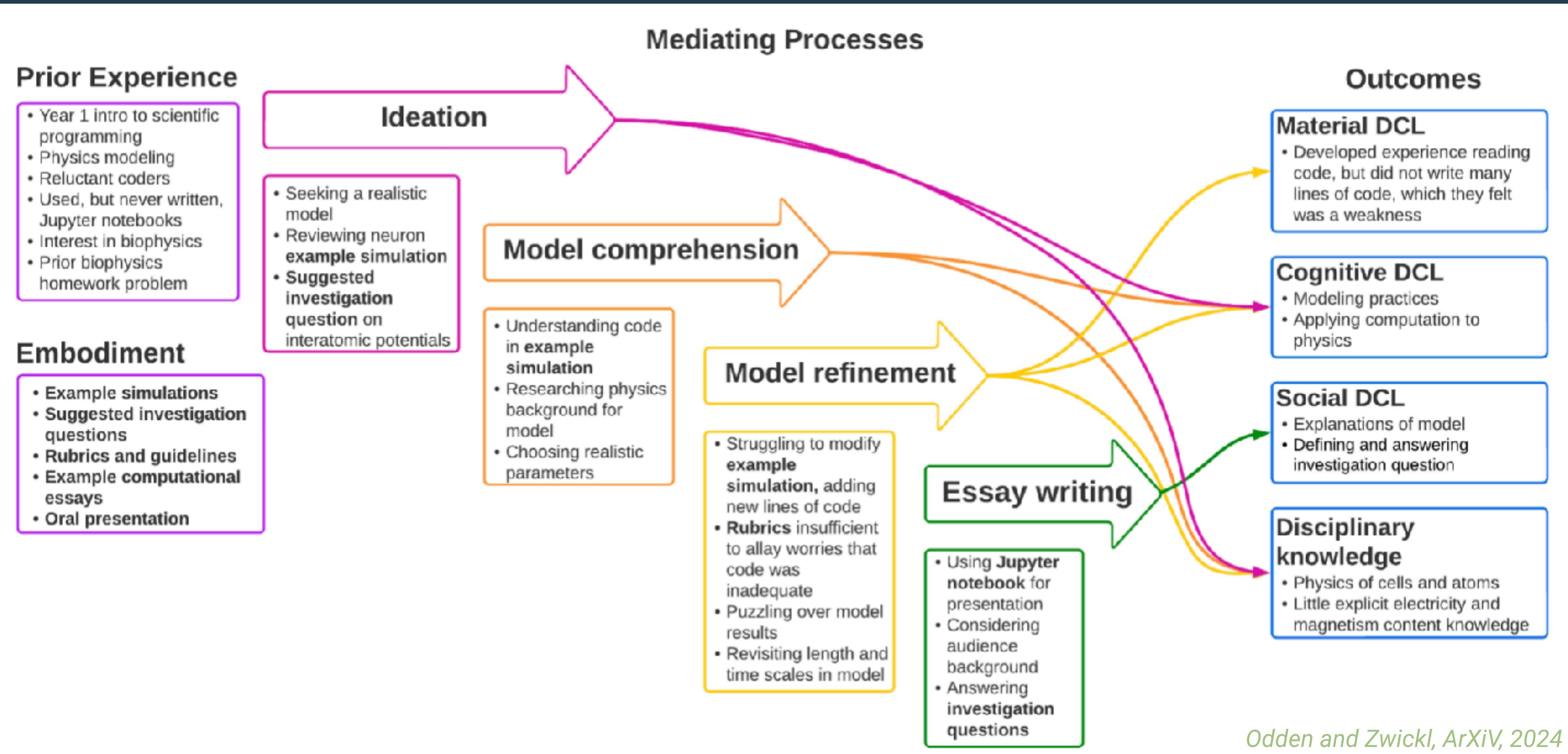
Tor Ole B. Odden^{1*} and Benjamin Zwickl^{1,2}

[1] Center for Computing in Science Education, Department of Physics, University of Oslo, 0316 Oslo, Norway

[2] School of Physics and Astronomy, Rochester Institute of Technology, 84 Lomb Memorial Drive, Rochester, NY, 14607

*t.o.b.odden@fys.uio.no (corresponding author)

PCL is a model that informs activity development & pedagogy

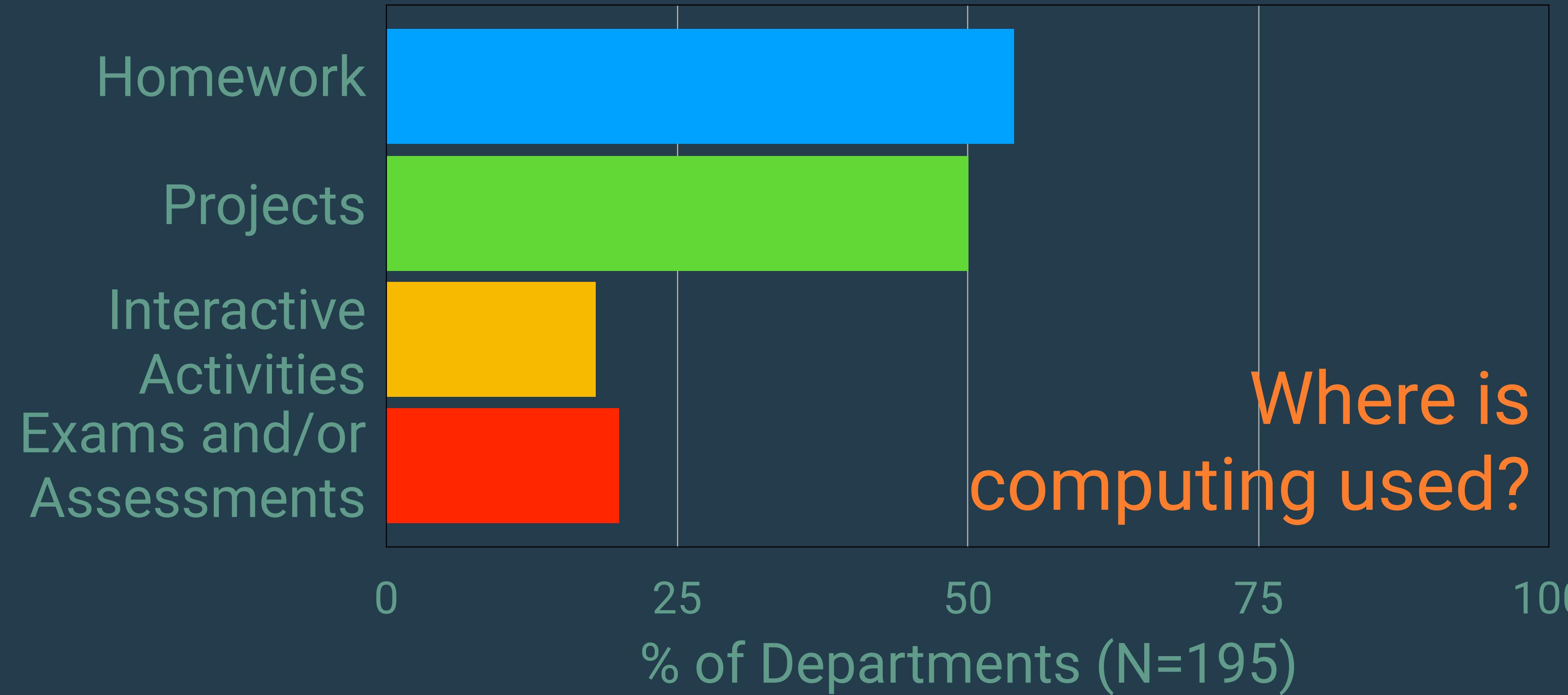


Twelve years have past between this paper and the first.

Who teaches computing in physics?

>50% departments report experience with teaching computing in physics

No prevalence differences between intro & advanced courses



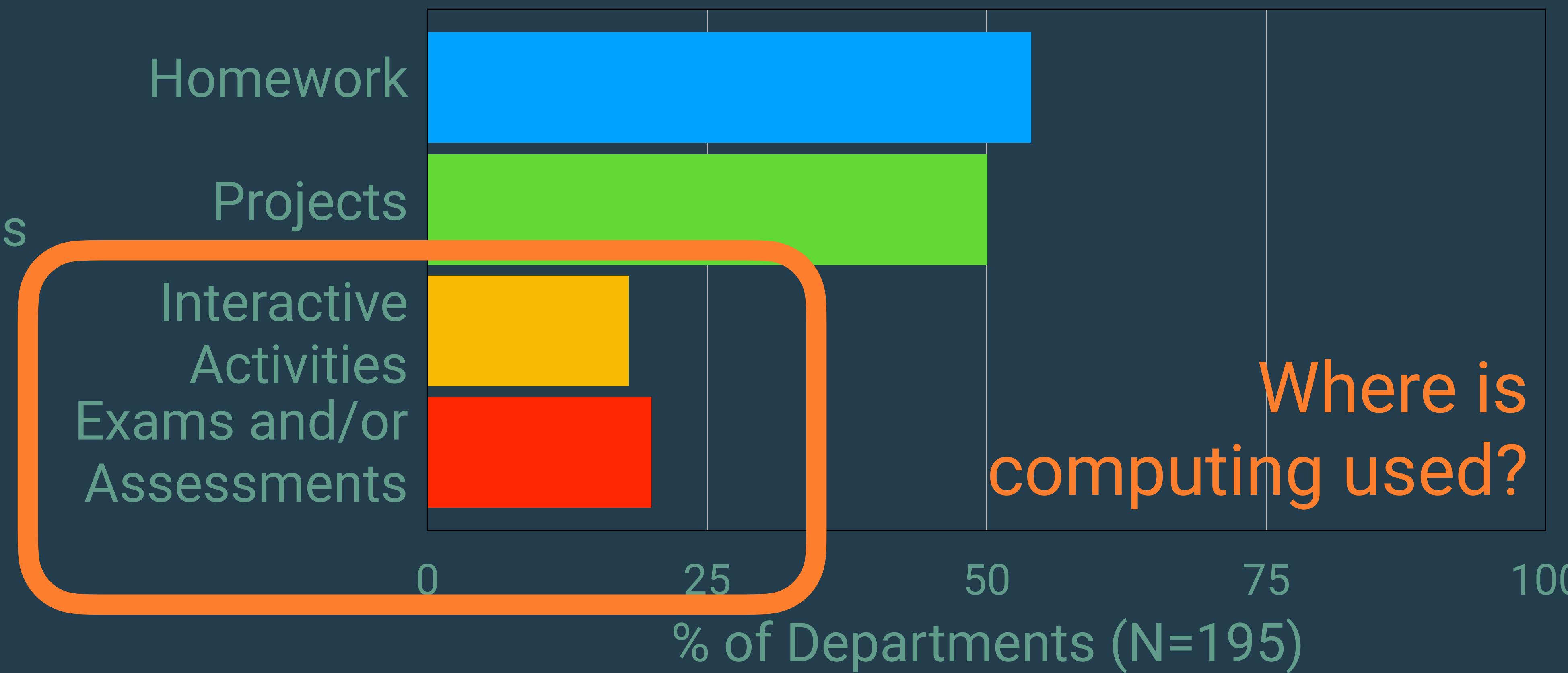
PICUP

Caballero & Merner, Phys. Rev. PER, 2018

Who teaches computing in physics?

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PICUP

Caballero & Merner, Phys. Rev. PER, 2018

But “who” teaches computation?



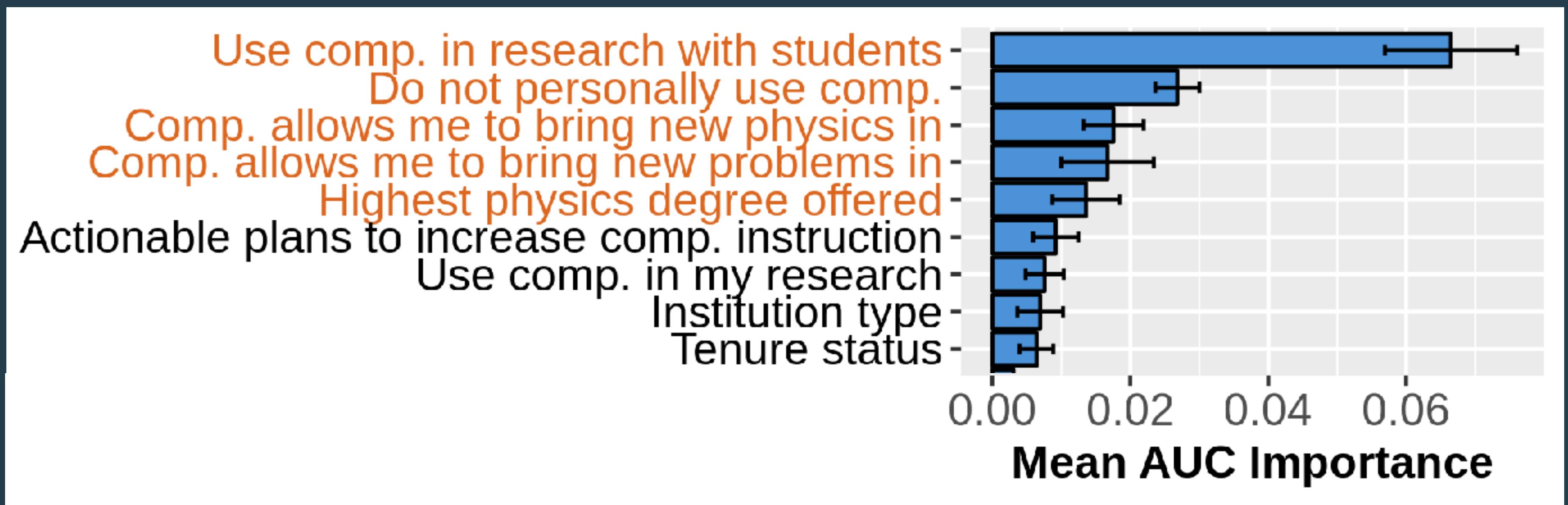
Rate on a scale of 1 (Strongly Agree) to 7 (Strongly Disagree)

Computational physics is hard to teach in the classroom.

My department rewards me for teaching computation.

Computation allows me to bring new physics into the classroom that I otherwise couldn't.

...



Sample was biased towards enthusiastic educators

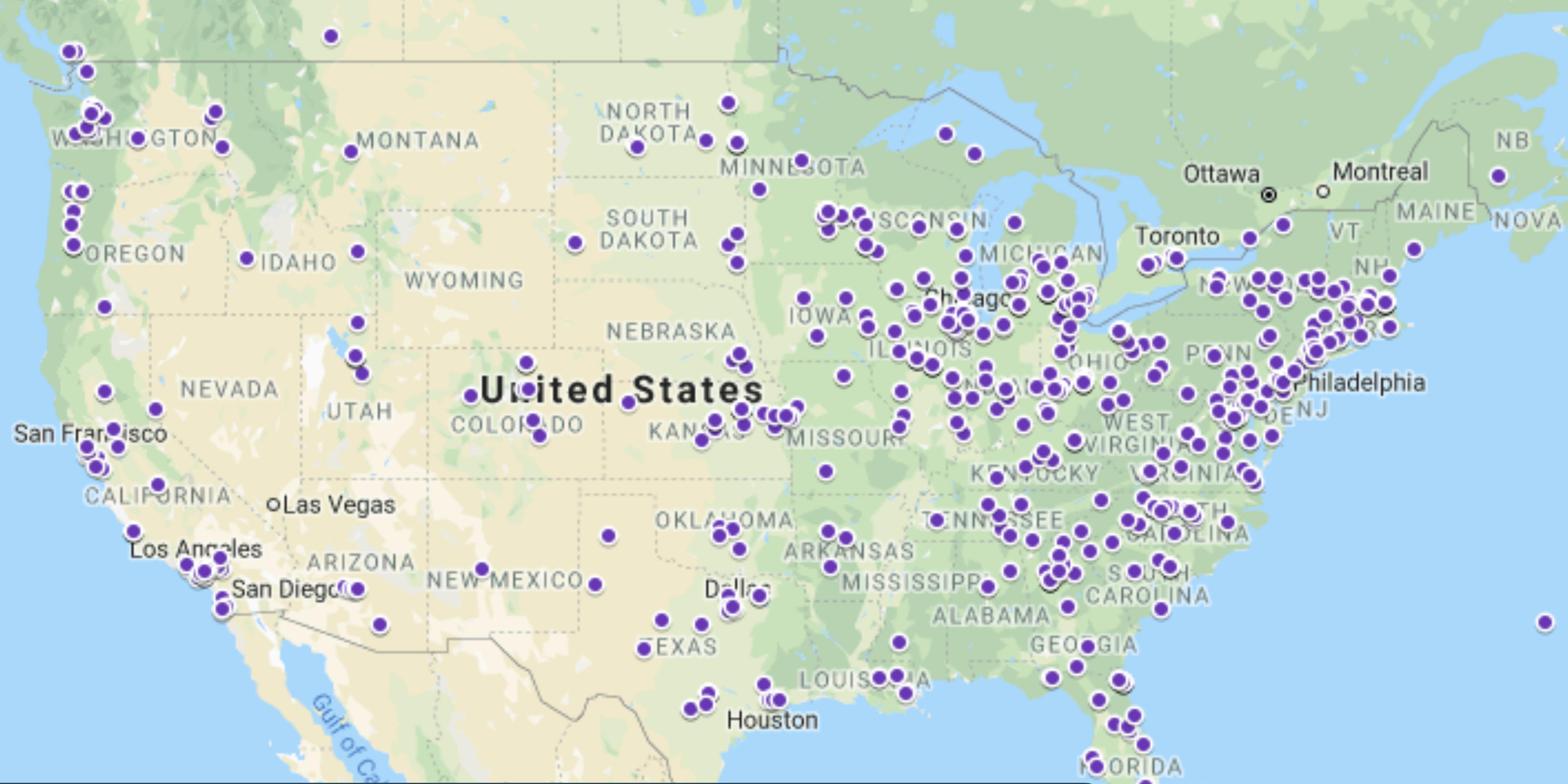


PICUP



PARTNERSHIP FOR INTEGRATION OF COMPUTATION INTO UNDERGRADUATE PHYSICS





Map of Verified Educators in the US

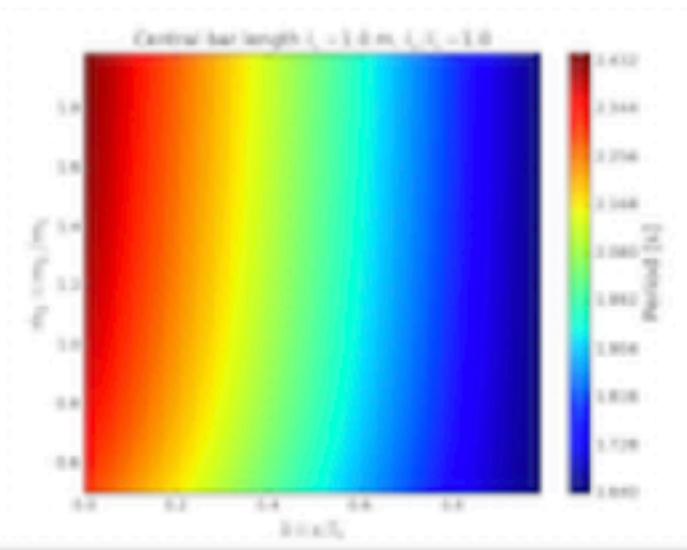


[Exercise Sets](#) » A Rigid Three-bar Pendulum

A Rigid Three-bar Pendulum

Developed by E. Behringer - Published July 31, 2016

This set of exercises guides the student in exploring computationally the behavior of a physical pendulum consisting of three bars. It also requires the student to generate, observe, and describe the results of simulating the rotational motion for different configurations of the pendulum. The numerical approach used is the half-step approximation (a modified Euler) method. Please note that this set of computational exercises can be affordably coupled to simple classroom experiments with meter sticks.



Subject Area Mechanics

Level Beyond the First Year

Available Implementation Python

Learning Objectives Students who complete this set of exercises will be able to

- express an equation predicting the period of small oscillations in terms of dimensionless ("scaled") variables suitable for coding (**Exercise 1**);
- produce both contour plots and 1D plots of the period of small oscillations versus scaled variables (**Exercises 1 and 2**);

Derive the equation of motion for the pendulum (**Exercise 3**);

Computationally model the motion of a three-bar pendulum with damping using the half-step approximation integration algorithm (**Exercise 4**);

Download Options

[Download Exercises - Word](#)

Share a Variation

Did you have to edit this material to fit your needs? Share your changes by

[Creating a Variation](#)

Credits and Licensing

E. Behringer, "A Rigid Three-bar Pendulum," Published in the PICUP Collection, July 2016.

The instructor materials are ©2016 E. Behringer.



The exercises are released under a [Creative Commons Attribution-NonCommercial-ShareAlike 4.0 license](#).

Colleges & Universities

Colleges & Universities

Physics Department

Colleges & Universities

Physics Department

Physics Course

Colleges & Universities

Physics Department

Physics Course

Class Meeting

Colleges & Universities

Physics Department

Physics Course

Class Meeting

Class Activity

Colleges & Universities

Physics Department

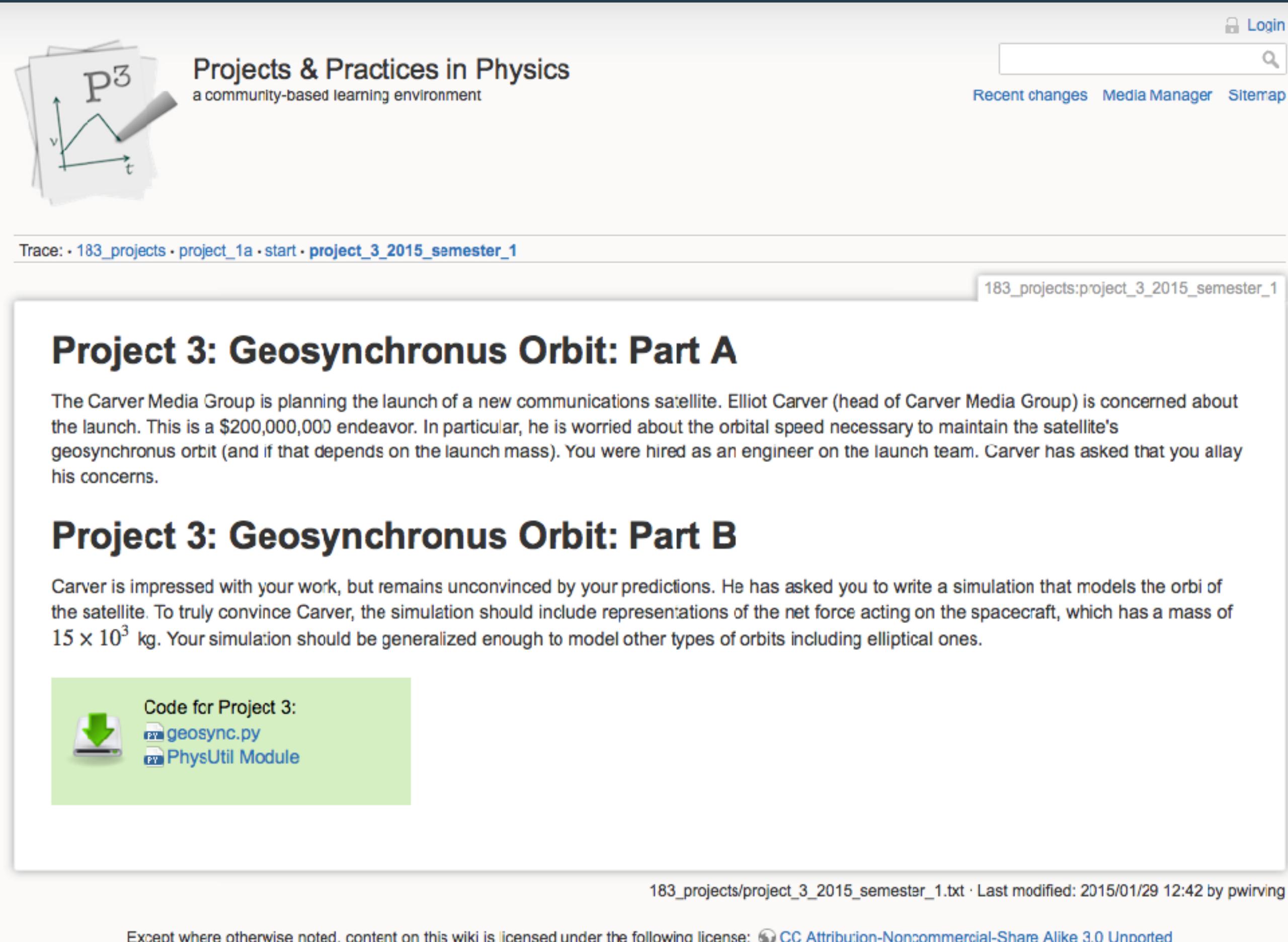
Physics Course

Class Meeting

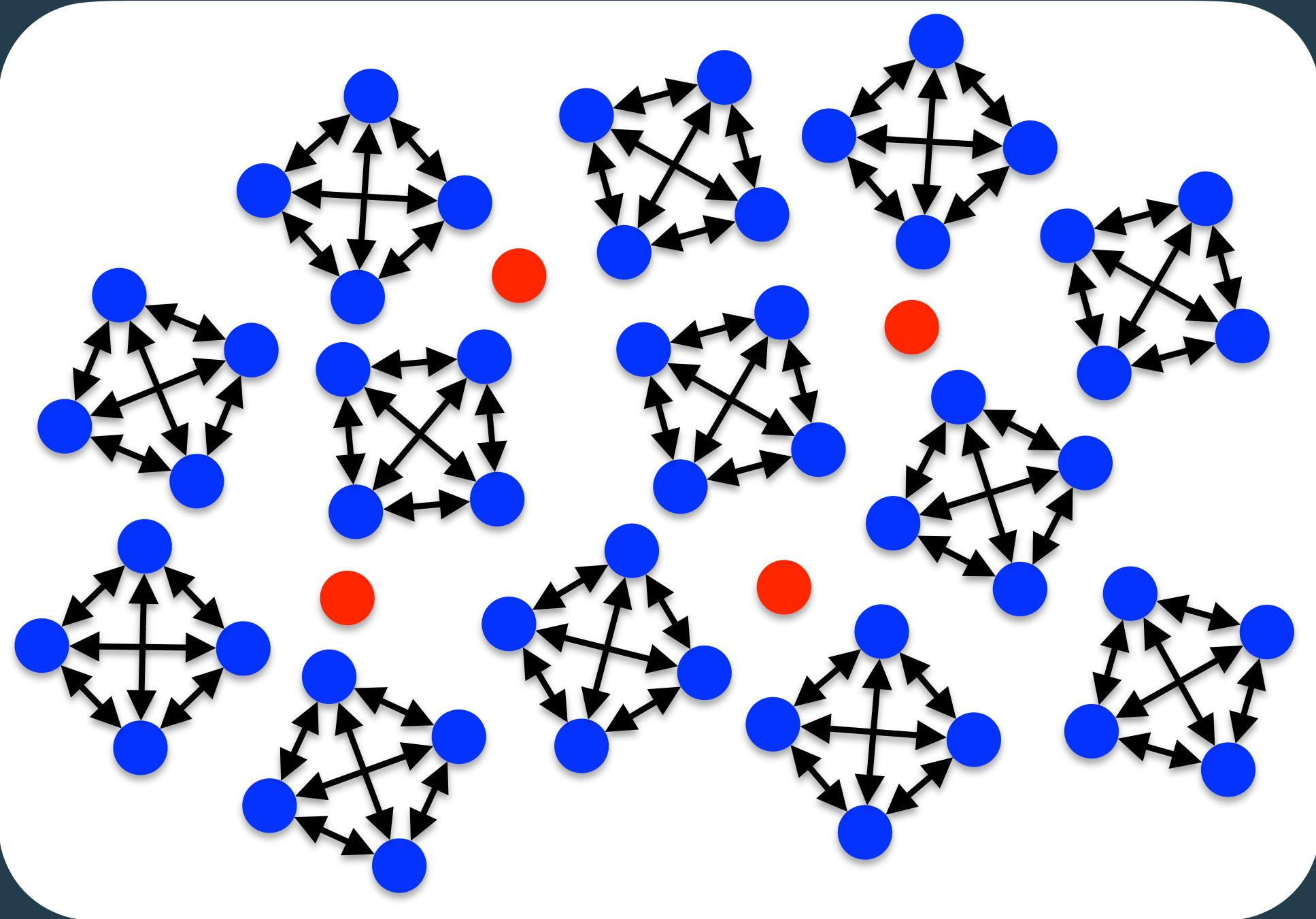
Class Activity

**Specific
Task**

Projects and Practices in Physics

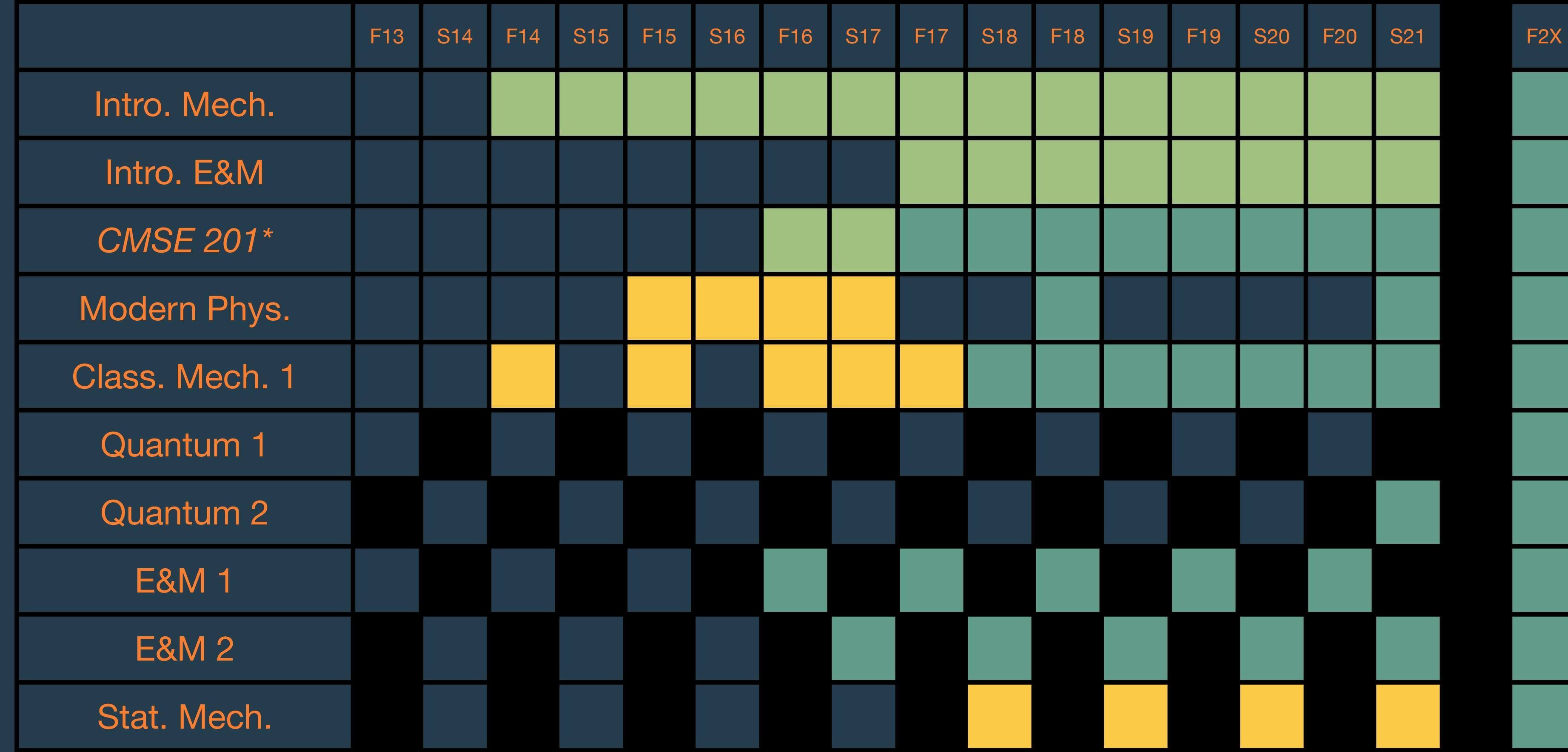


The screenshot shows a web-based learning environment for physics projects. At the top left is a logo with a graph and the letters 'P³'. The title 'Projects & Practices in Physics' and subtitle 'a community-based learning environment' are displayed. A navigation bar includes 'Login', a search bar, 'Recent changes', 'Media Manager', and 'Sitemap'. Below the header, a breadcrumb trail shows 'Trace: 183_projects · project_1a · start · project_3_2015_semester_1'. The main content area features a heading 'Project 3: Geosynchronous Orbit: Part A'. A text block describes a scenario where Carver Media Group is launching a satellite and asks for orbital speed calculations. Below this is another heading 'Project 3: Geosynchronous Orbit: Part B' with a text block about convincing Carver with a simulation. A green button labeled 'Code for Project 3:' with download icons for 'geosync.py' and 'PhysUtil Module' is present. At the bottom, a footer note states 'Except where otherwise noted, content on this wiki is licensed under the following license: CC Attribution-Noncommercial-Share Alike 3.0 Unported'.



Timeline of Integrating Computation at MSU

Typical Course Progression



Use of computational environment (e.g., plotting)

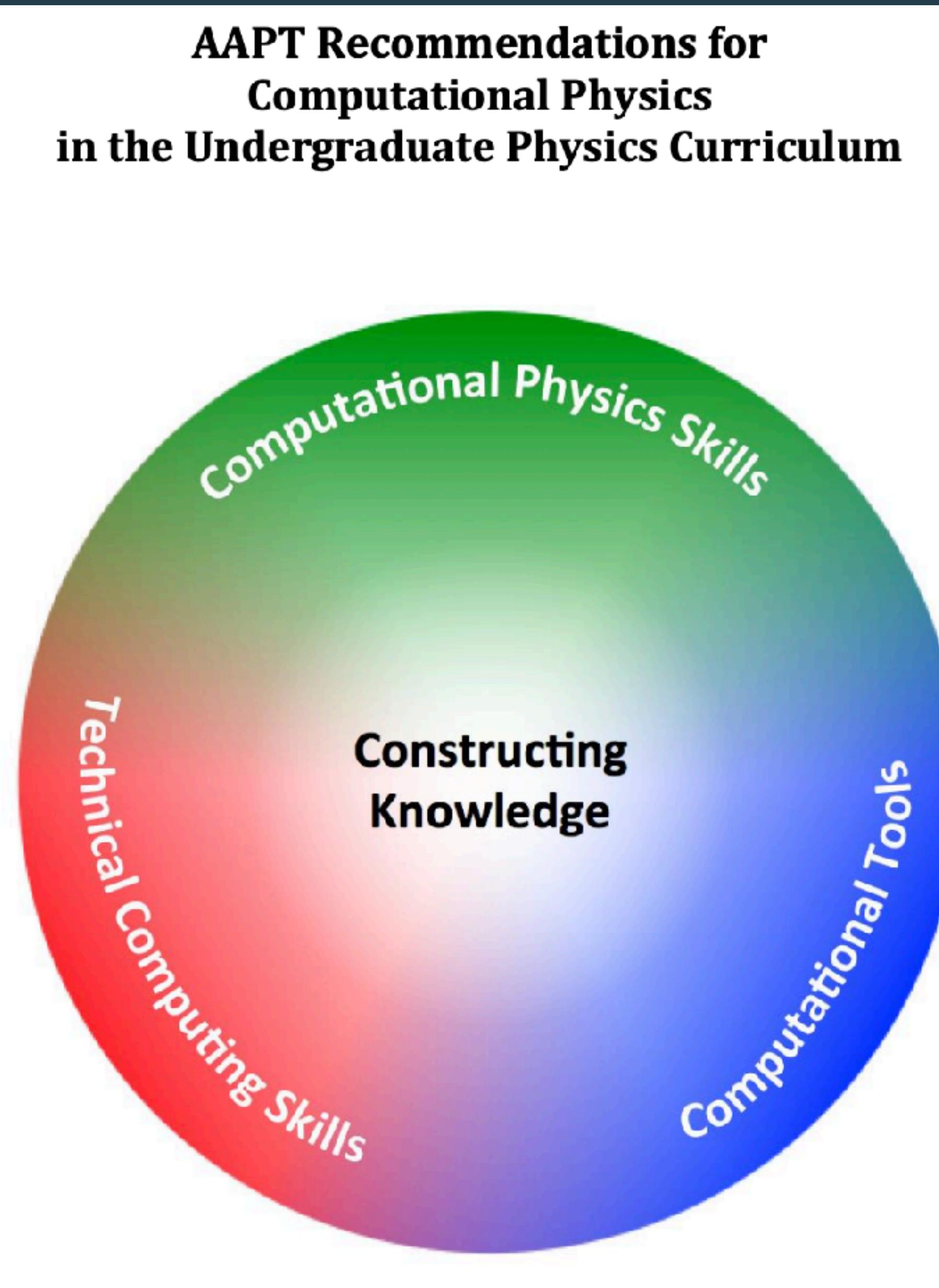
Instruction in computation (some sections)

Instruction in computation



Not offered

Spring 2016
Department votes to integrate computing across the program.



What should students know and be able to do with computing in physics?

Computational Physics Skills

Translate a model into code
Subdivide a model into a set of manageable computational tasks

Technical Computing Skills

Process data
Represent data visually

Computational Tools

Spreadsheets
MATLAB, Mathematica
Python, C, Fortran

2021 PICUP Virtual Capstone Report



“Directions for the next decade”

- Better defined learning goals for computation in each course.
- Development and testing student assessments
- Developing and testing department-wide integration
- Expanding number and diversity of departments and faculty

The screenshot shows the EP3 website interface. At the top, there's a purple header bar with the EP3 logo, the text "Effective Practices for Physics Programs", and links for "FAQ", "Events", "Contact", and "About". Below this is a white navigation bar with icons for "Guide Overview" (calculator), "Get Started" (play button), "Map Your Program's Goals" (chart), "Help & Community" (person talking), and "Search" (magnifying glass). The main content area has a pink banner at the top with a collage of physics-related images. Below the banner, the page title is "Guide to Computational Skills". The page navigation includes "Home > Guide Overview > Computational Skills". A note says "Version 1. January 29, 2021" and there's a link to "Contributors and Reviewers". A horizontal menu bar below the title includes "Description", "Benefits", "Effective Practices", "Programmatic Assessments", "Resources", "Evidence", and "Glossary".

EP3 Guide for Departments

Shared effective practices for physics programs to adopt

Departments should strive to:

- Establish goals and a plan for providing students with computational skills
- Integrate opportunities to develop computational skills into the curriculum
- Provide students early and continuing opportunities to learn and apply computational skills
- Communicate the value of computation in physics and for a broad range of careers

2019 K12 Computing in Science Visioning Report

Integration of computation must **emphasize values native to the discipline in which computing is being integrated** and demonstrate a clear alignment with existing standards

Educational leaders need to **recognize that relevant computing content differs across the sciences**, ruling out a “one size fits all” notion of integrating computing in science.

Diversity, Equity and Inclusion must be built into all efforts to integrate computation with science education.

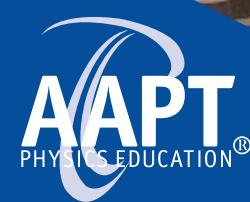
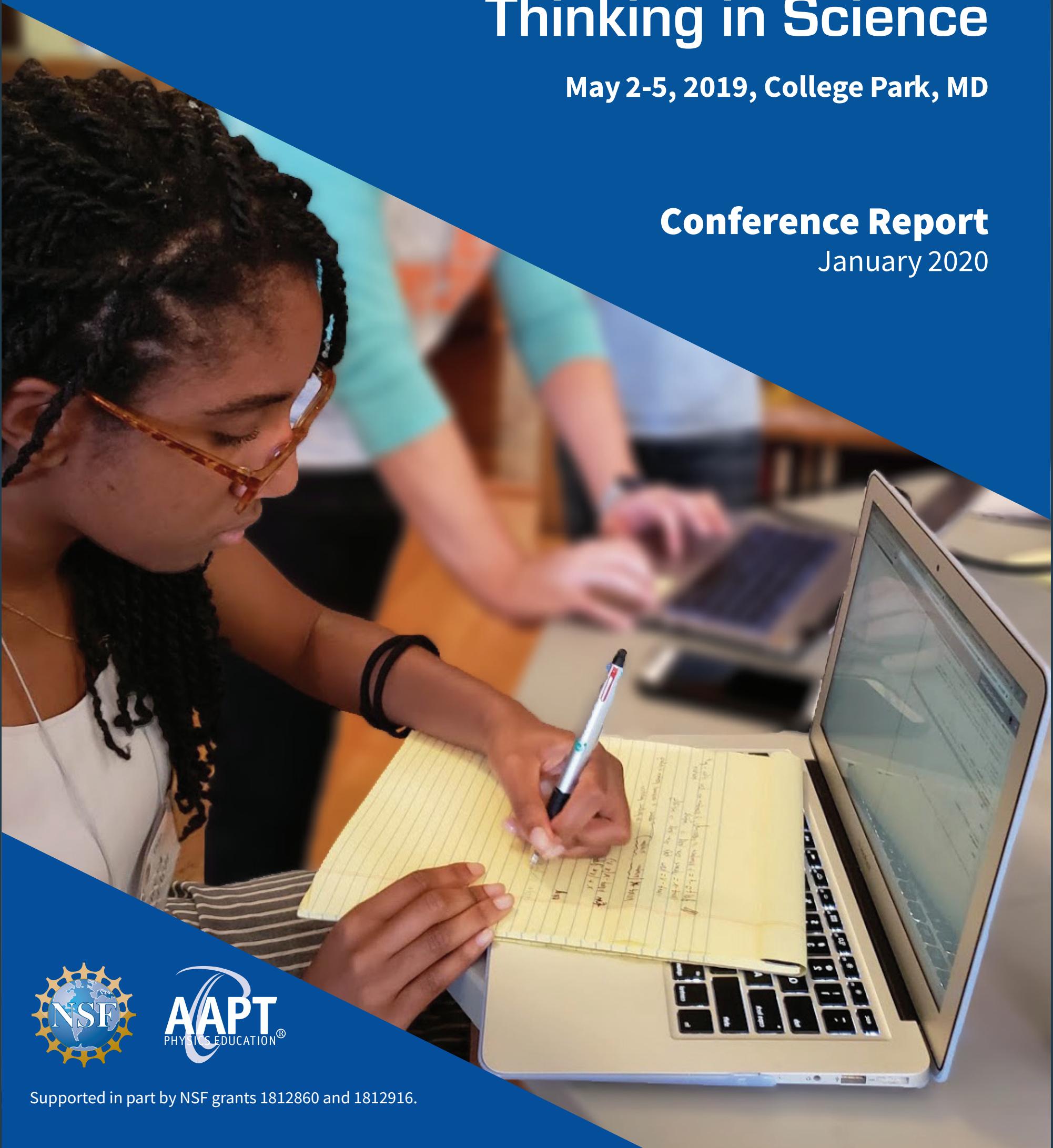
K-12 teachers need **sustained professional development and support** to learn and teach science while leveraging computing.

Research is needed to understand and assess computational integration. There are **relatively few theories of how computation impacts science learning**. There are also **very few useful assessments** for charting progress.

Advancing Interdisciplinary Integration of Computational Thinking in Science

May 2-5, 2019, College Park, MD

Conference Report
January 2020



Supported in part by NSF grants 1812860 and 1812916.

Integrating Computing in Science Across the Mitten



Michigan K-12 Standards
Science



November 2015



Create a **computational model** to calculate...

Use mathematical and/or **computational representations** to support explanations of factors...

Use mathematical or **computational representations** to predict the motion...



ICSAM Workshop



Weeklong Summer Camp for High School Teachers

- Introduce computing
- Develop materials
- Grow community
- Focus on equity



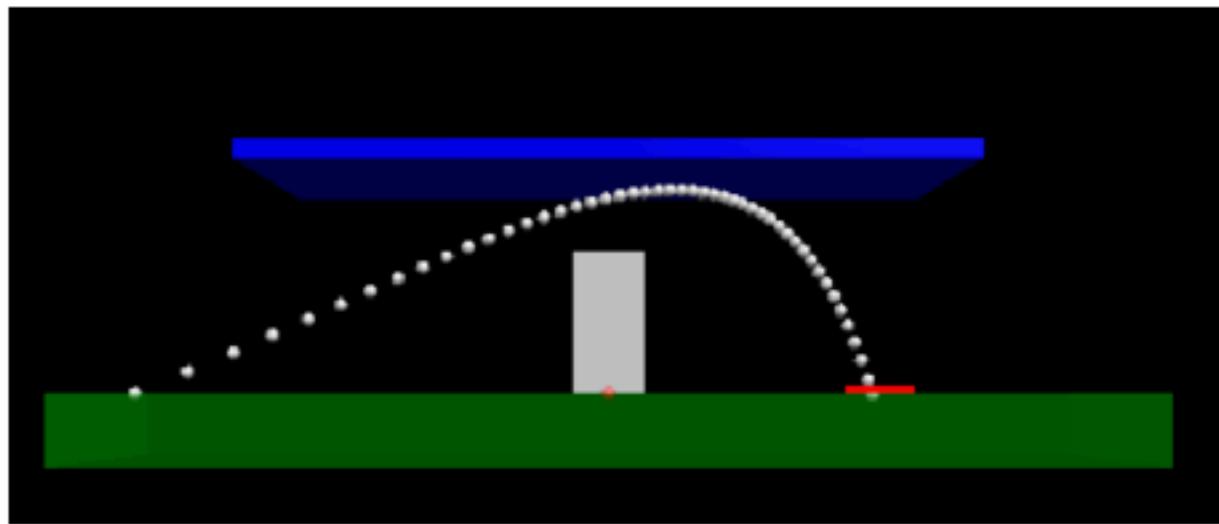
Return to MSU

- Addressing problems of practice
- Community building

ICSAM Workshop



Marshmallow Launch



Activity Information

Learning Goals

- Create and modify a computational model to describe a given system
- Use Newton's second law to relate the acceleration of a marshmallow with the forces acting on it ([HS-PS2-1](#))

Weeklong Summer Camp for High School Teachers

- Introduce computing
- Develop materials
- Grow community
- Focus on equity

Return to MSU

- Addressing problems of practice
- Community building

Many teacher-developed materials!



ICSAM is also a research lab

PHYSICAL REVIEW PHYSICS EDUCATION RESEARCH **18**, 020109 (2022)

Editors' Suggestion

Students' perspectives on computational challenges in physics class

Patti C. Hamerski^a,¹ Daryl McPadden,¹ Marcos D. Caballero,^{1,2} and Paul W. Irving¹

¹Department of Physics and Astronomy, Michigan State University, East Lansing, Michigan 48824, USA

²Department of Physics and Center for Computing in Science Education, University of Oslo, N-0316 Oslo, Norway

PHYSICAL REVIEW PHYSICS EDUCATION RESEARCH **18**, 020106 (2022)

Development and illustration of a framework for computational thinking practices in introductory physics

Daniel P. Weller^b,^{1,2} Theodore E. Bott,¹ Marcos D. Caballero^b,^{1,3,4} and Paul W. Irving¹

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COMPUTER SCIENCE EDUCATION
2020, VOL. 30, NO. 3, 254–278
<https://doi.org/10.1080/08993408.2020.1805285>

Routledge
Taylor & Francis Group

Check for updates

Racial hierarchy and masculine space: Participatory in/equity in computational physics classrooms

Niral Shah^{ID}^a, Julie A. Christensen^b, Nickolaus A. Ortiz^c, Ai-Khanh Nguyen^a, Sunghwan Byun^{ID}^b, David Stroupe^b and Daniel L. Reinholtz^{ID}^d

^aCollege of Education, University of Washington, Seattle, USA; ^bCollege of Education, Michigan State University, East Lansing, MI, USA; ^cCollege of Education & Human Development, Georgia State University, Atlanta, GA, USA; ^dCollege of Sciences, San Diego State University, San Diego, CA, USA

ABSTRACT
Background and Context: Computing is being integrated into a range of STEM disciplines. Still, computing remains inaccessible to many minoritized groups, especially girls and certain people of color. In this mixed methods study, we investigated racial and

ARTICLE HISTORY
Received 31 October 2019
Accepted 31 July 2020

KEYWORDS

Tracking Inequity: An Actionable Approach to Addressing Inequities in Physics Classrooms

Julie Christensen, Michigan State University, East Lansing, MI
Niral Shah, University of Washington, Seattle, WA
Nickolaus Alexander Ortiz, Georgia State University, Atlanta, GA
David Stroupe, Michigan State University, East Lansing, MI
Daniel L. Reinholtz, San Diego State University, San Diego, CA

Recent studies reveal people from marginalized groups (e.g., people of color and women) continue to earn physics degrees at alarmingly low rates.^{1–3} This phenomenon is not surprising given reports of the continued perception of physics as a masculine space^{4,5} and the discrimination faced by people of color and women within the field.^{6–8} To realize the vision of an equitable physics education, fully open to and supportive of marginalized groups, teachers need ways of seeing equity as something that is concrete and actionable on an everyday basis. In our work, teachers have found value in intentionally reflecting on their instruction and their students explicitly in terms of race, gender, and other social markers. We find they are then better positioned to build equitable physics classrooms. Without a focus on specific social markers, common obstacles such as color-evasiveness emerge, which obstruct the pursuit of equity in classrooms.⁹

learners.^{12,13} Therefore, we encourage teachers to consider past and contemporary forms of marginalization when determining standards of fairness. In other words, we recommend a “reparations-type” view when defining equity.

In this article, we present a three-step process involving a classroom observation tool called EQUIP (<https://www.equip-ninja/>), which teachers can use to identify and attenuate patterns of discourse inequity. We begin by describing EQUIP and how its design supports physics teachers in thinking about equity in terms of social marker patterns in typical teaching and learning situations. Then, we illustrate how our partner teachers used EQUIP in action, as they sought to build equitable spaces for collaborative computation-based high school physics.

EQUIP: Equity QUantified In Particular



Seemingly necessary but not sufficient conditions for change

How was this effort to integrate computing in physics done?

- Define goals and scope collectively
- Build professional development and community
- Respect institutional factors and diversity
- Acknowledge the complexity of the problem
- Collect data on experience and progress
- Share successful cases openly and transparently

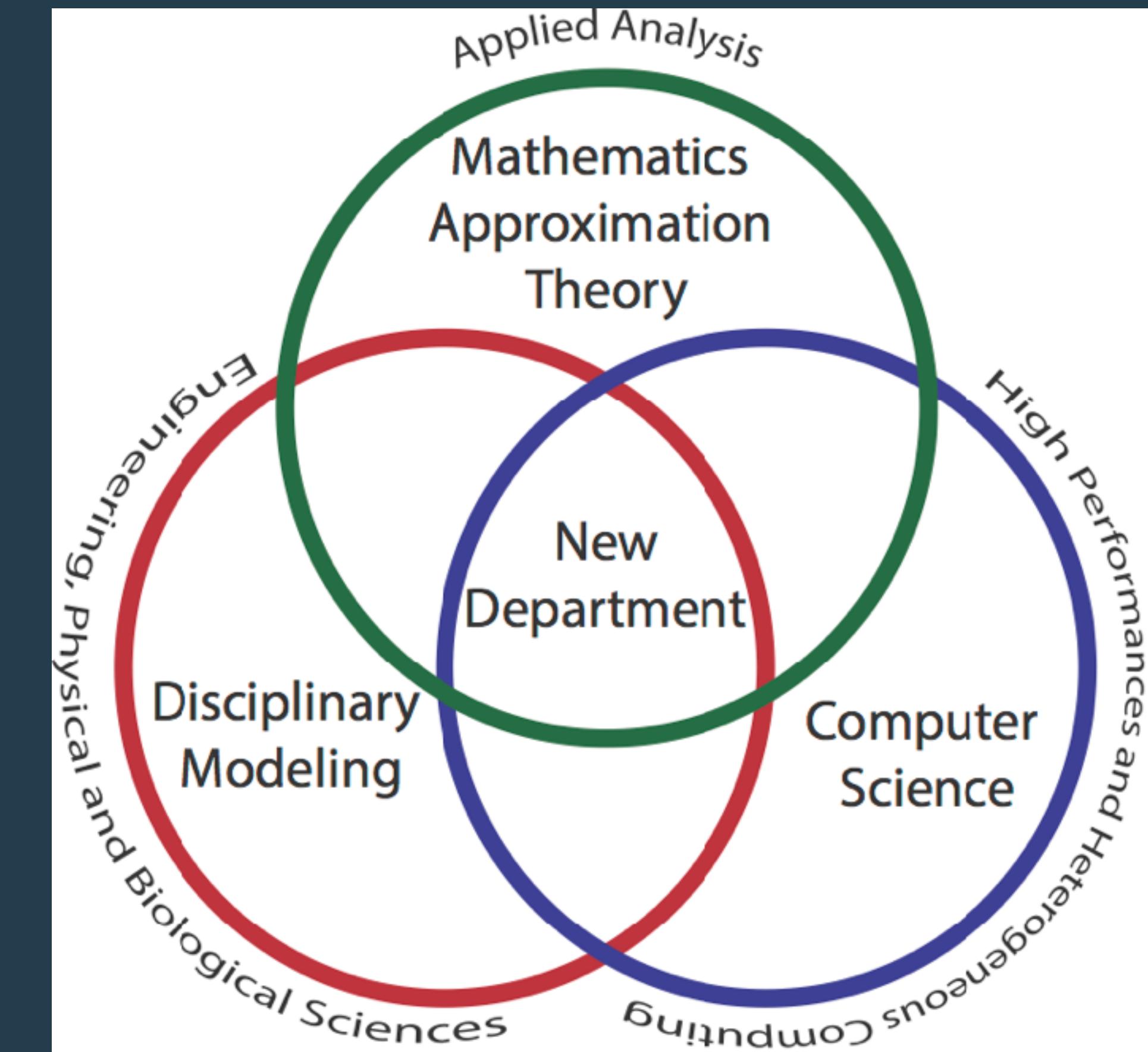
Must happen in
disciplinary contexts

Needs scientists, educators,
& ed. researchers

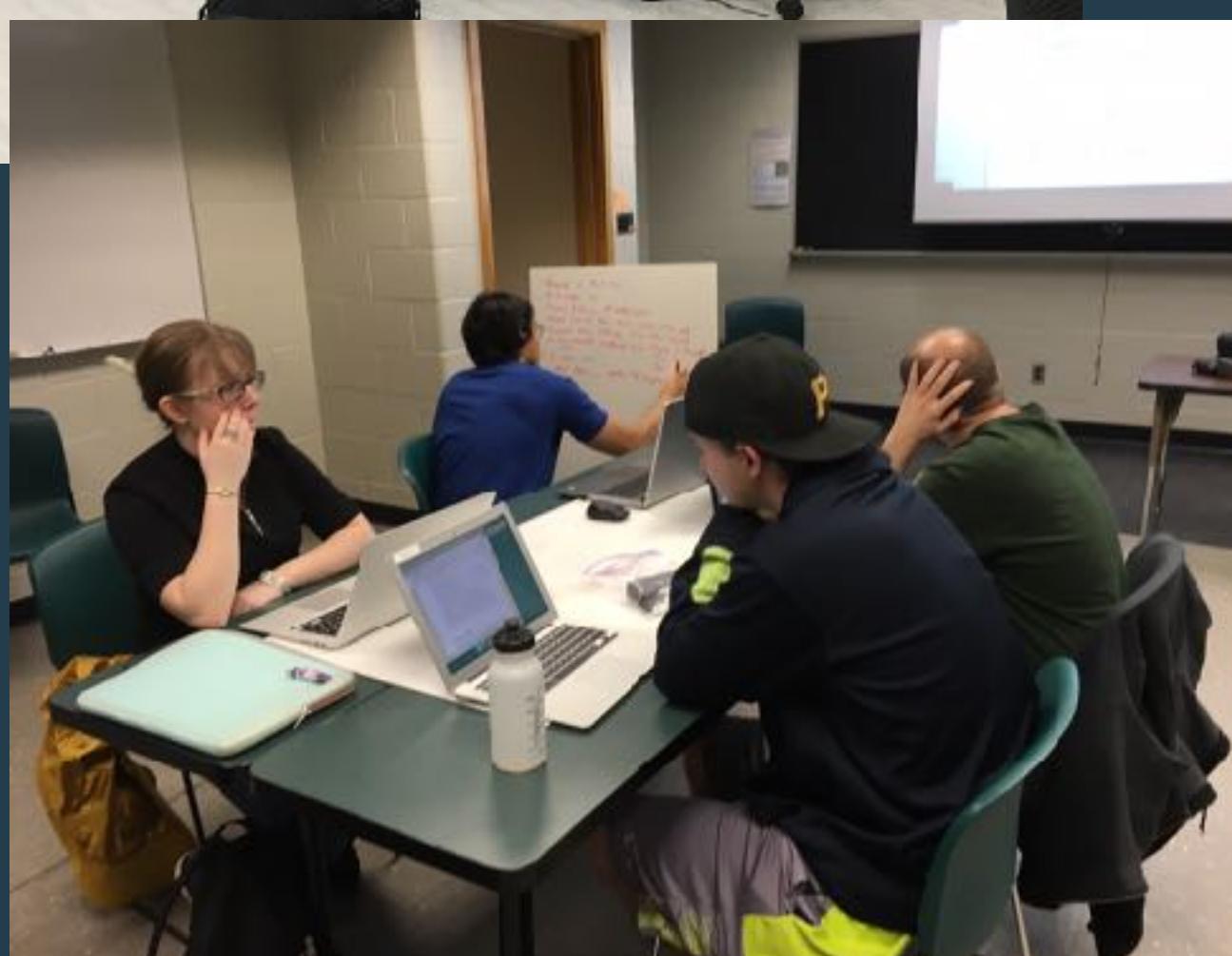
Computational science: using computers to analyze and solve scientific and engineering problems.

- Computer Science focuses on the science of computing
- CMSE focuses on computing to do science

BS, MS, and PhD granting department



We teach computational and data science



From the articles:

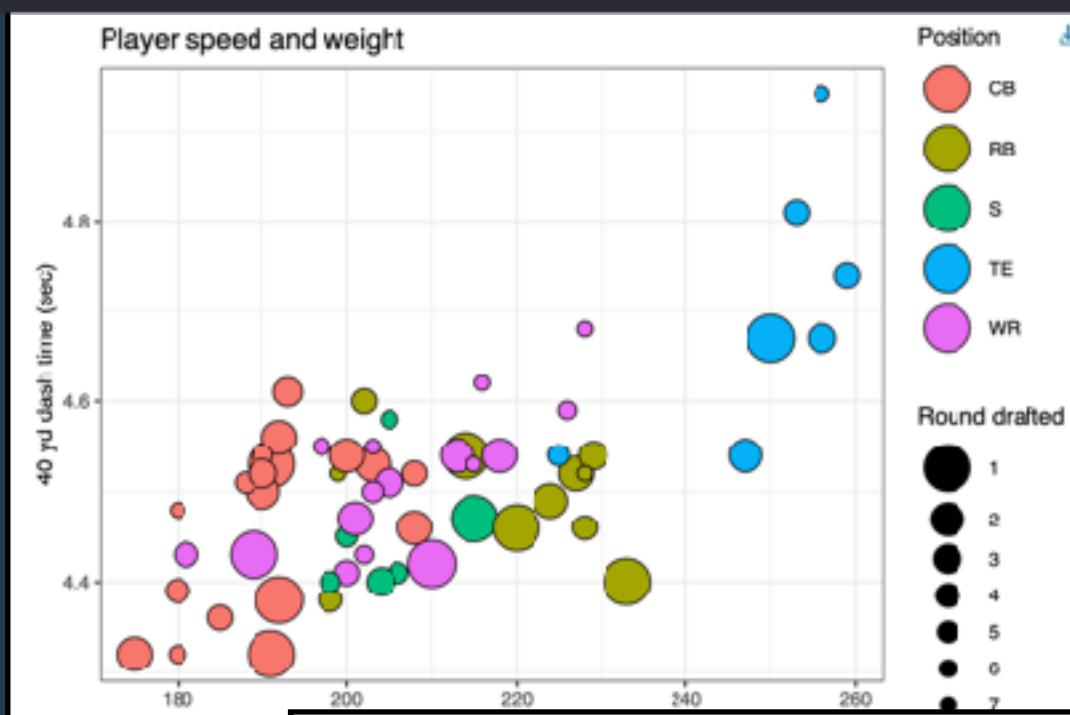
Summarize the main points of the article you read. You had your choice of three linked on D2L (around 250–500 words).

In your group, discuss how the articles and videos were related to data ethics and justice. Summarize your discussion below (around 250–500 words).

Some questions to consider:

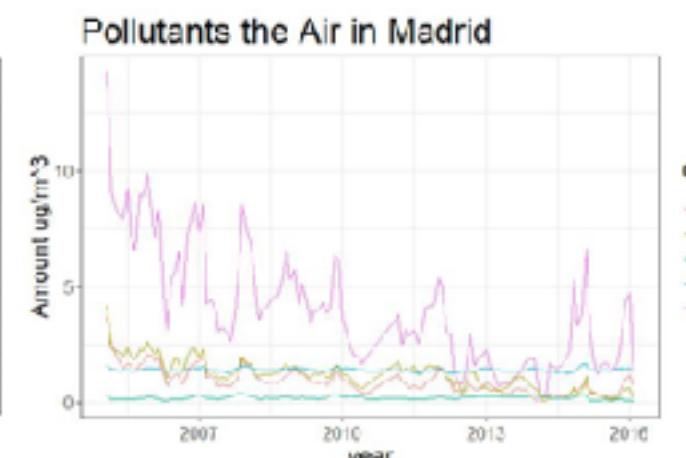
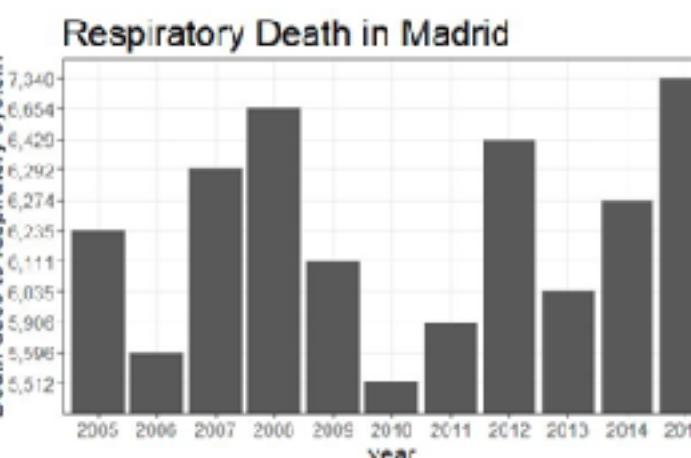
- How is data being used?
- How does the actual usage of data relate to its intended usage?
- Who owns and/or controls the data?
- Who benefits from the data usage?
- How is data usage related to privacy?
- How is data usage related to bias?

What do data ethics mean to you?



Defining Respiratory Diseases

National Cancer Institute defines respiratory diseases as asthma, chronic obstructive pulmonary disease (COPD), pulmonary fibrosis, pneumonia, and lung cancer.



Basic Numerical Integration: the Trapezoid Rule

A simple illustration of the trapezoid rule for definite integration:

$$\int_a^b f(x) dx \approx \frac{1}{2} \sum_{k=1}^N (x_k - x_{k-1}) (f(x_k) + f(x_{k-1})).$$

First, we define a simple function and sample it between 0 and 10 at 200 points

```
In [1]: %matplotlib inline
import numpy as np
import matplotlib.pyplot as plt

In [2]: def f(x):
    return (x-3)*(x-5)*(x-7)+95

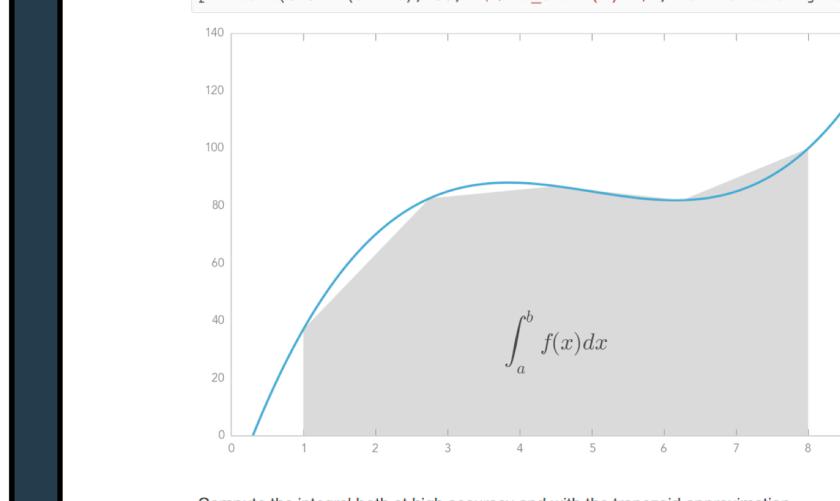
x = np.linspace(0, 10, 200)
y = f(x)
```

Choose a region to integrate over and take only a few points in that region

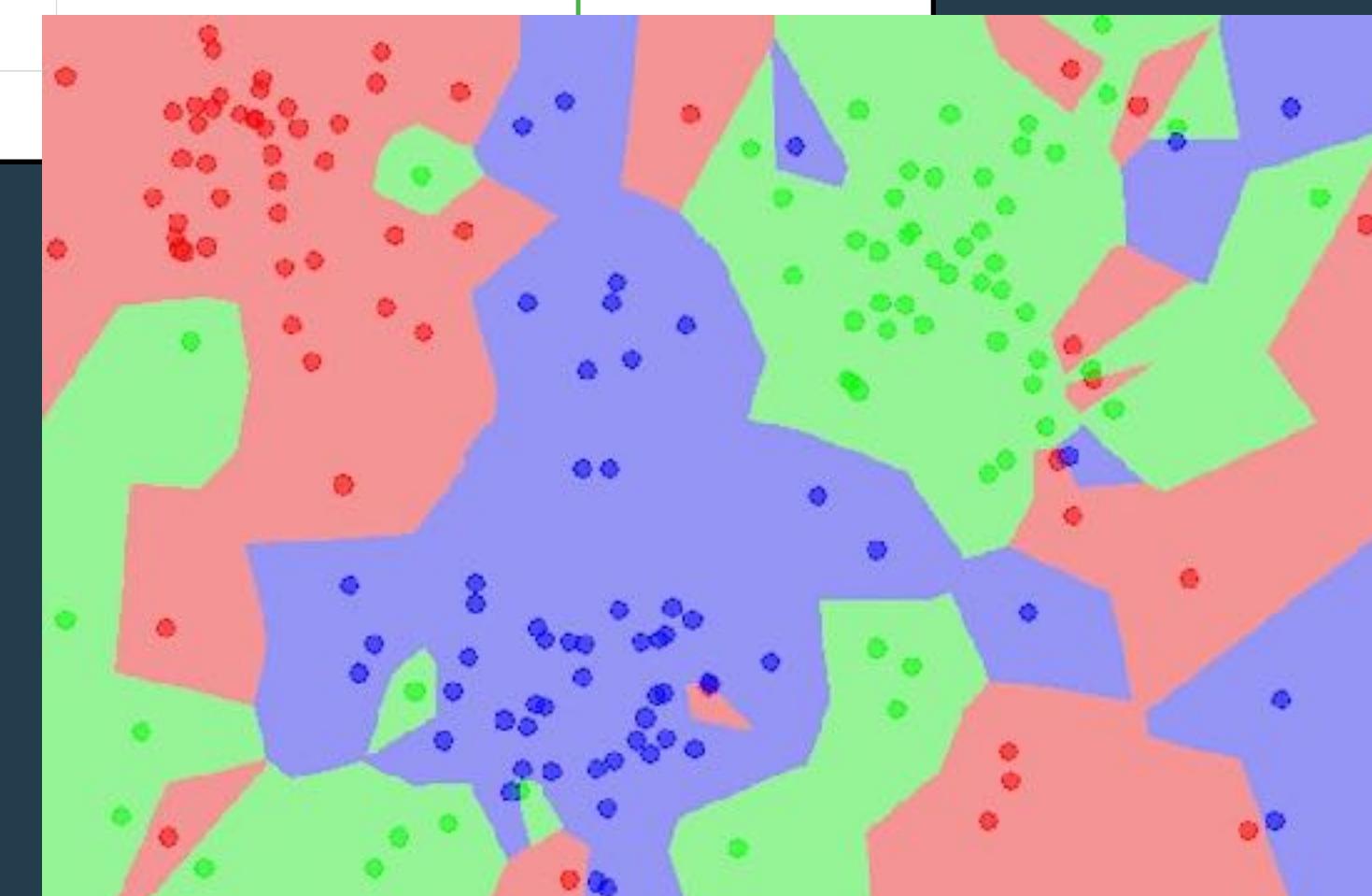
```
In [3]: a, b = 1, 8 # the left and right boundaries
N = 5 # the number of points
xint = np.linspace(a, b, N)
yint = f(xint)
```

Plot both the function and the area below it in the trapezoid approximation

```
In [4]: plt.plot(x, y, lw=2)
plt.axis([0, 9, 0, 140])
plt.fill_between(xint, 0, yint, facecolor='gray', alpha=0.4)
plt.text(0.5 * (a + b), 30,r"$\int_a^b f(x)dx$",
horizontalalignment='center', fontsize=20);
```



Compute the integral both at high accuracy and with the trapezoid approximation



Markdown +
LaTeX

Python

Inline Plots

Introductory Computational Science

Learning Goals for CMSE 201



1. Gain insight into physical, biological, and social systems through the use of computational algorithms and tools.
2. Write programs to solve common problems in a variety of disciplines.
3. Identify salient features of a system that can be codified into a model.
4. Manipulate, analyze, and visualize datasets and use to evaluate models.
5. Understand basic numerical methods and use them to solve problems.
6. Synthesize results from a scientific computing problem and present it both verbally and in writing.

For any STEM major - pre-req: Calculus 1

Integrated Progression

Modeling, Context, and Programming work together

Time ↓	Modeling/Data Analysis Concept	Context/Application	Programming Practices/Tools
	Order of magnitude estimation	Varied (e.g. estimating population)	Variable definition, simple math
	Mathematical representations of physical systems	Kinematics, projectile motion	Defining lists, writing loops
	Evaluating the state of physical systems	Kinematics, projectile motion	Boolean logic/conditional statements, functions
	Computing costs and optimizing solutions	Designing a ride share service	Functions, Python modules (e.g. matplotlib)
	Visualizing models	Projectile motion and population growth	NumPy
	Manipulating and visualizing data	Waters levels of the Great Lakes	Loading/reading data files, making plots

and so on...

Two Concerns (for now)

I'm taking introductory computational science; can you give me three example questions for using functions for plotting? we use python with numpy and matplotlib.

Memory updated
Here are three example and Matplotlib:

1. Plotting a Sine Wave

- Write a Python function that plots a sine wave with values between -1 and 1.

Certainly! Variable scope in Python refers to the region where a variable is accessible. There are two main scopes to consider:

- Local scope:** Variables declared inside a function are local to that function.
- Global scope:** Variables declared outside of any function can be accessed globally, including inside functions, unless overridden.

Here's a working example where variable scope is handled correctly:

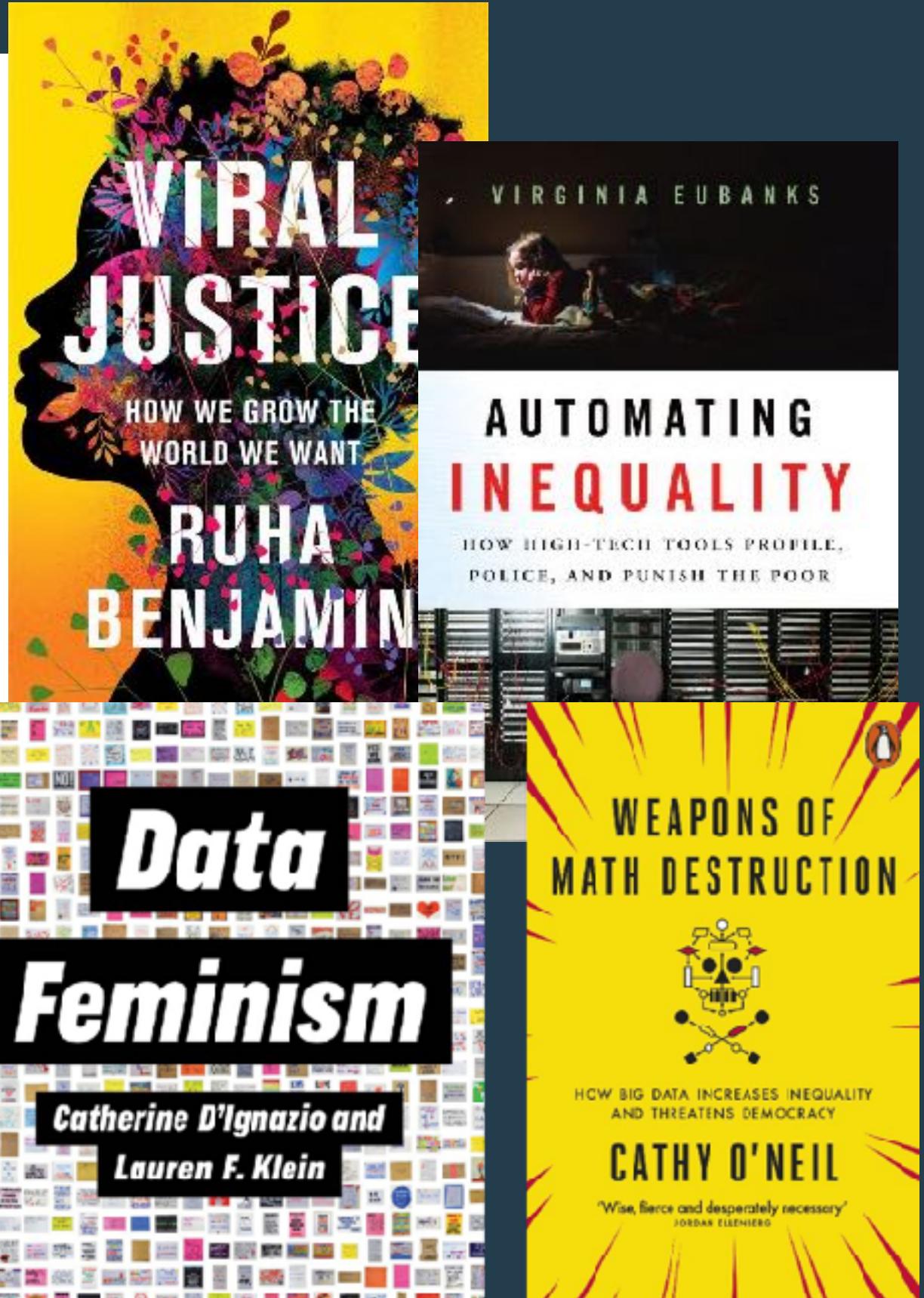
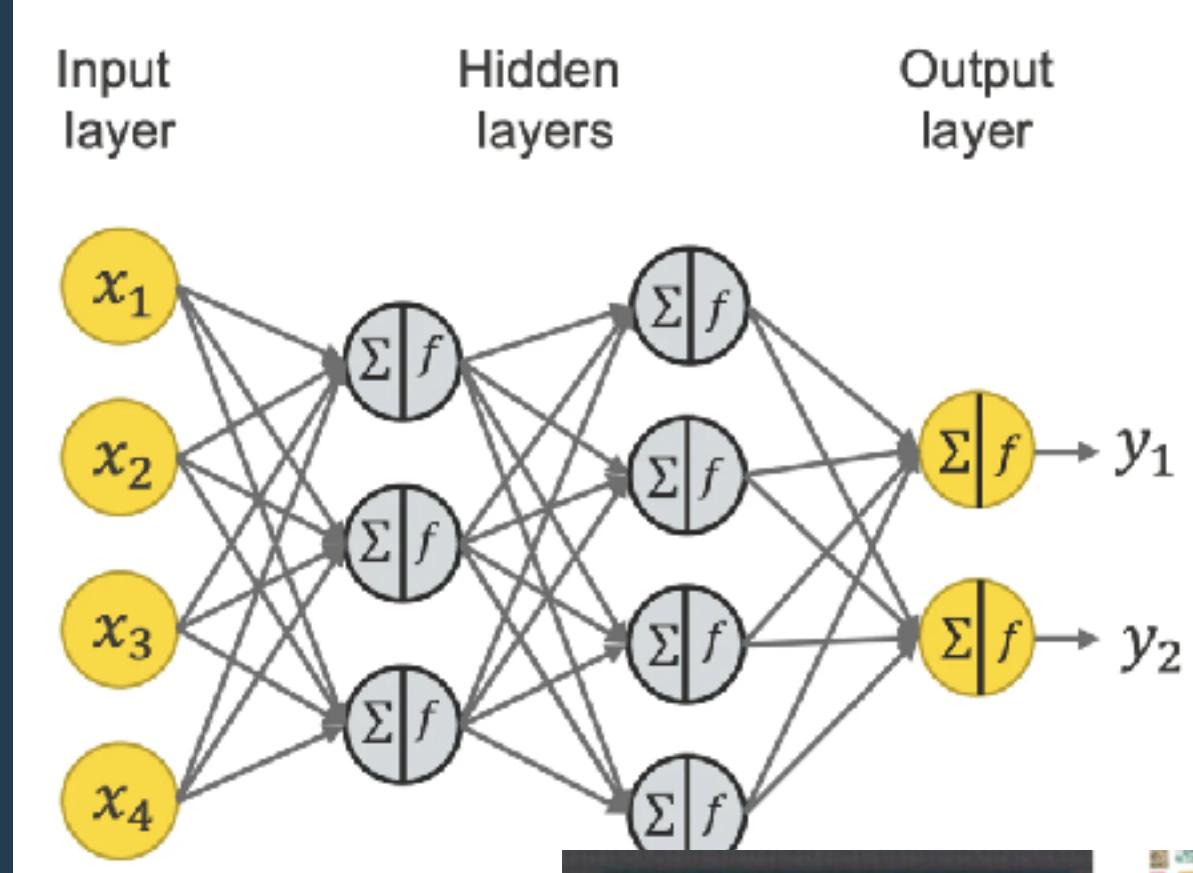
Working Example

```
python
import numpy as np
import matplotlib.pyplot as plt

def plot_sine_wave():
    x = np.linspace(0, 2 * np.pi, 100)
    y = np.sin(x)
    plt.plot(x, y)
    plt.title("Sine Wave Plot")
    plt.xlabel("X-axis")
    plt.ylabel("Y-axis")
    plt.show()

plot_sine_wave()
```

Output:



TechTrends
<https://doi.org/10.1007/s11528-023-00835-z>

ORIGINAL PAPER

Racial Justice Amidst the Dangers of Computing Creep: A Dialogue

Niral Shah¹ · Aman Yadav²

Educating students for
a world with ML & AI

The Use of AI in CMSE classrooms

Framing the AI issue

No single frame is used exclusively in practice. All have value in context.

Technological Solutionism:
tech can provide the necessary
solutions

- dealing with issues of scale
- addressing funding & efficiency
- emphasize personalization
- take advantage of new tech

*Sal Khan, Clayton Christensen,
Sugata Mitra, Eric Hanushek,
Michelle Rhee, Daphne Koller,
Sebastian Thrun*

Human-centered Education:
social relationships are
paramount

- emphasize critical thinking,
- leverage experiential learning
- promote socioemotional
development
- center humans in tech

*John Dewey, Nel Noddings,
Seymour Papert, Andrea DiSessa,
Pasi Sahlberg*

Education as a tool for Justice
education is a political act of
liberation

- promote diversity & equity
- emphasize social justice and
liberation
- educational systems
perpetuate inequality

*Paulo Freire, bell hooks,
Henry Giroux, Ruha Benjamin,
Gloria Ladson-Billings,
Angela Valenzuela*

What is the relationship between education in science and artificial intelligence?

we need more research, but we have some questions to start

How do students develop an understanding of and relationship with AI in science classrooms?

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How does teaching students science change when AI can write nearly all the code they would use?

How does AI exacerbate or mitigate inequities in science learning?

How do we engage a broad cross-section of scientists in this work?

Final Takeaways

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- It's important that we engage with AI and science education. It will require an authentic and collective effort.

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- It's essential that we design for AI in science classrooms. The future of science appears to demand it.

Final Takeaways

- It's important that we engage with AI and science education.
It will require an authentic and collective effort.
- It's essential that we design for AI in science classrooms.
The future of science appears to demand it.
- It's gonna be a lot of work.
But a lot of fun, too.

Thank you!



Questions?

caballero@pa.msu.edu
dannycab.github.io



And thanks to our sponsors

