Computer Science Teachers Association

the world's largest CS teaching department

BT (Bryan Twarek)
VP of Education & Research
bt@csteachers.org

CSTA

CSTA unites, supports, and empowers educators to enhance the quality, accessibility, and inclusivity of computer science education.

Build Community

Provide PD

Guide Teachers

Every student prepared for a world powered by computing.

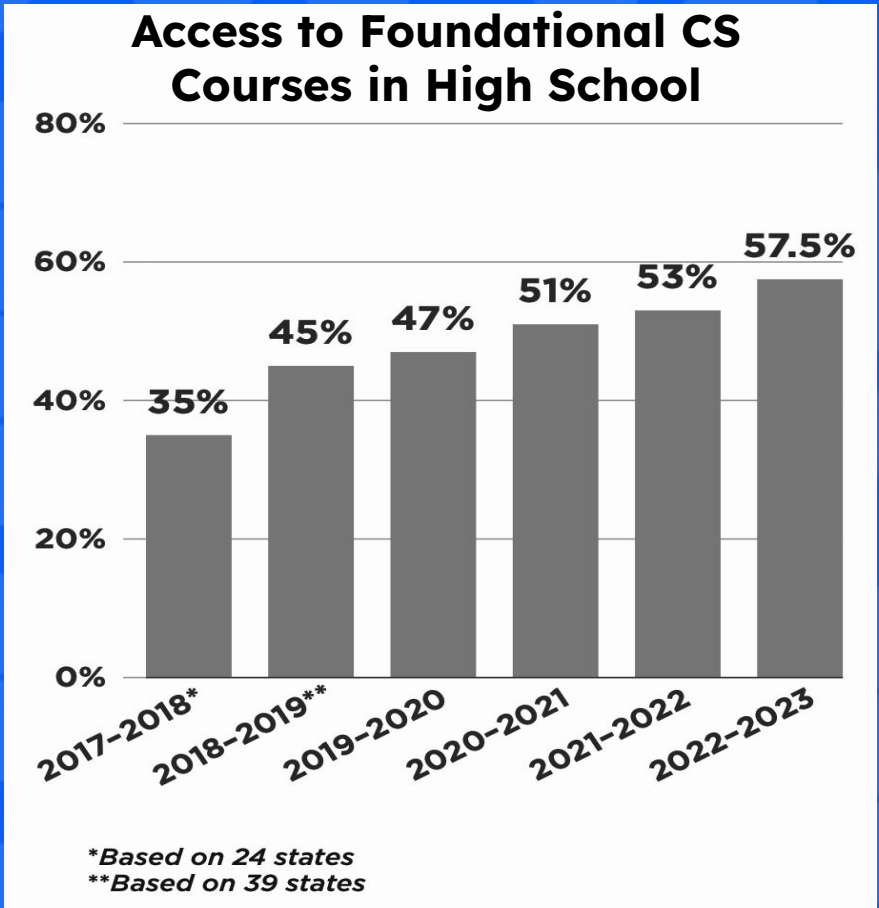
This sleep app seems to be helping-- but is my personal health data safe?

The ad just recommended I try that bakery -- are they tracking my location?

Is this email about unclaimed property a scam?

Should I support the candidate who promises to regulate AI?

Some → Every Student



Persistent Inequities

- **Race/Ethnicity:** 67-78% Native, Black, and Latine vs. 82-89% White and Asian
- **Gender:** 31% girls vs. 69% boys
- **Locale:** 55% urban and rural vs. 67% suburban
- **School Size:** 41% small vs. 90% large

+ (Dis)ability, Language Skills, SES…

Data from 2023 State of CS Report (Code.org, CSTA, & ECEP Alliance, 2023)

Convene representatives from K-12 ed, higher ed, and industry to develop community definitions of:

1. what CS content is essential for all high school graduates, and
2. pathways for continued CS learning.

Reimagining CS Pathways

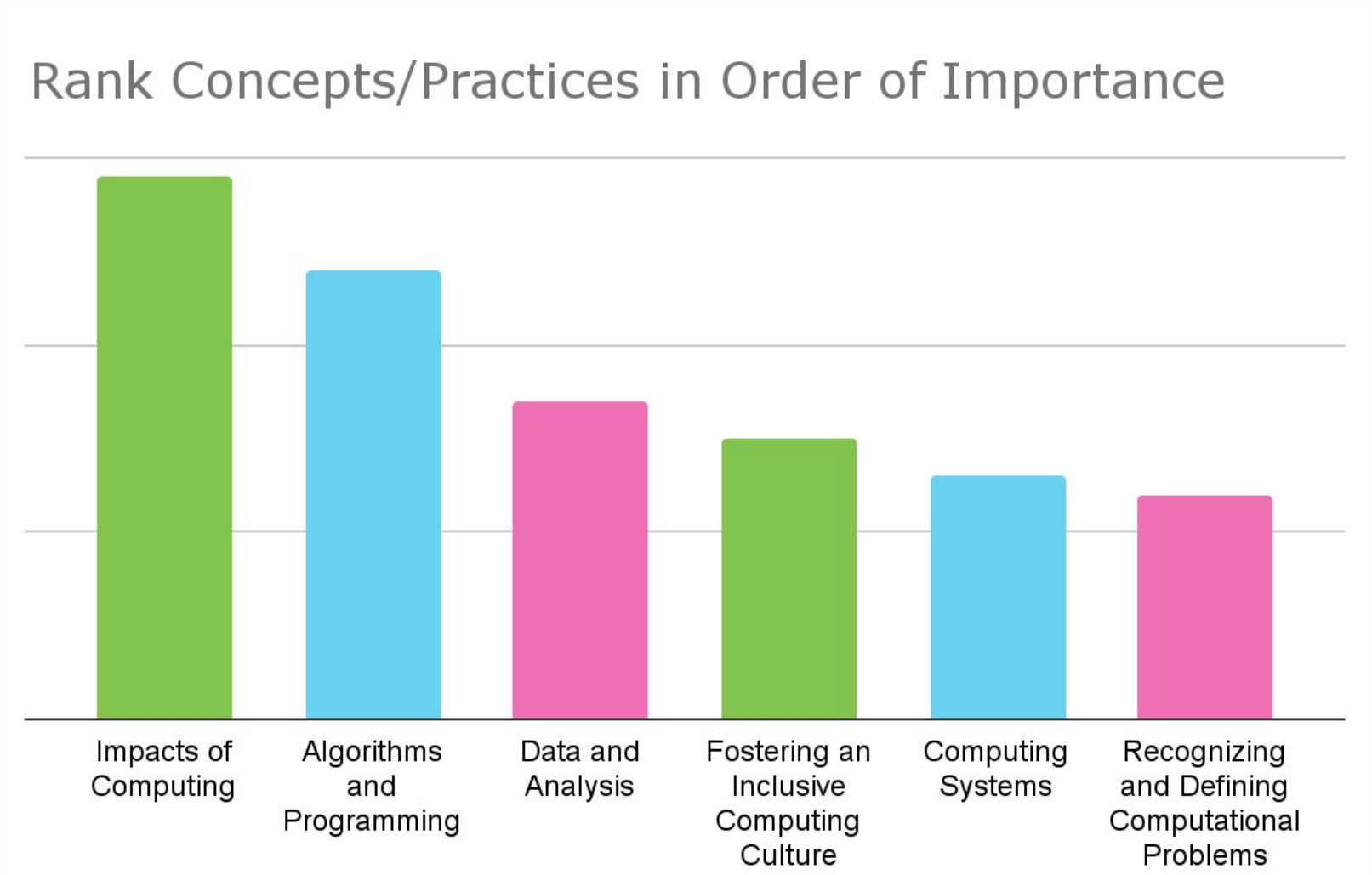
High School and Beyond

CSTA

The Foundation

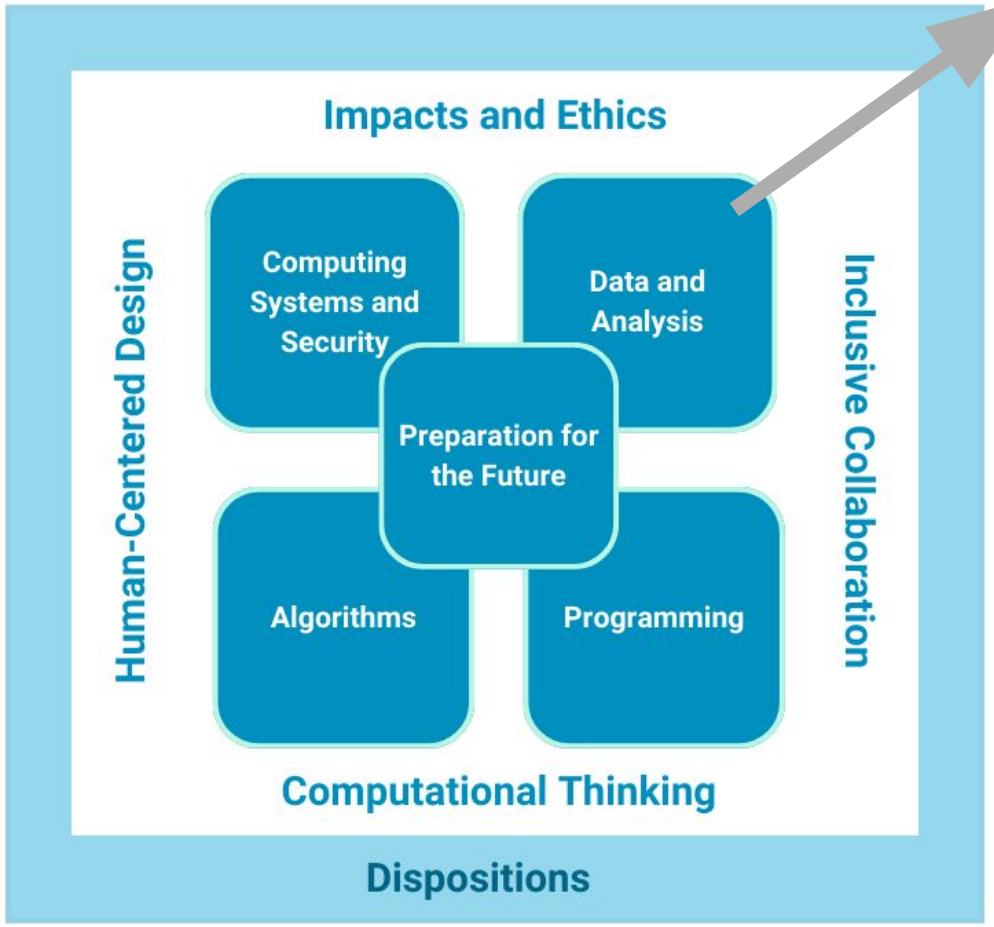
CS content that is essential for **all** high school graduates to learn

What is Prioritized?



- Impacts and ethics
- Algorithms and programming
  - Reading, modifying, debugging code
- Focus on data
- Inclusivity and human-centered design
- Computing systems & security
- Artificial intelligence
- Careers

The Foundation at a Glance



Remember	**Identify and define data types (e.g., string, numeric, Boolean)**
	Identify basic data formats (e.g., tables, schemas, JSON)
Understand	Describe, at a high level, the role of data in AI/ML applications
	Understand the difference between data and metadata
Apply	Manipulate (e.g., normalize, transform, clean) data
Analyze	Trace how data moves through a program
Evaluate	Evaluate approaches to cleaning data in a given context
	Assess whether and how a given question can be answered with data, and what specific data is needed
	Assess societal impacts of data analysis and related ethical issues (e.g., biased data used to train AI systems, attribution related to products of generative AI)
	Evaluate data visualizations for clarity, potential biases, etc.
Create	**Select, organize, interpret, and visualize large data sets from multiple sources to support a claim and/or communicate information**
	Devise plans for using data to solve a problem

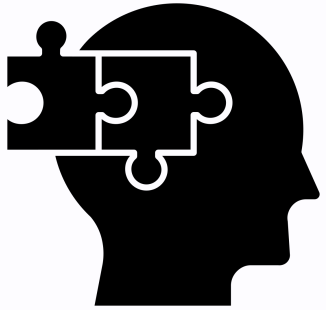
Dispositions

Persistence

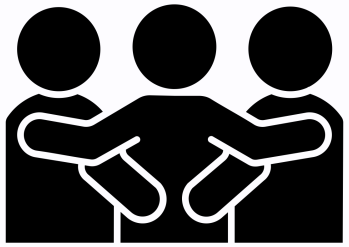
Reflectiveness

Creativity

Curiosity



Critical Thinking



Sense of Belonging in CS

Resourcefulness

Foundational High School Computer Science Content

ALGORITHMS	• Define *algorithm*, including traditional and AI/ML algorithms • Compose, modify, and interpret algorithms • Decompose a problem into multiple subproblems • Evaluate aspects of different algorithms
PROGRAMMING	• Convert an algorithm to code • Modify a program • Articulate whether a program solves a given problem • Systematically test and debug a program
DATA AND ANALYSIS	• Describe, at a high level, the role of data in AI/ML applications • Manipulate (e.g., normalize, transform, clean) data • Trace how data moves through a program • Evaluate data visualizations • Work with large data sets
COMPUTING SYSTEMS AND SECURITY	• Identify various types of hardware and software • Describe why/how cybersecurity is important • Explain what networks (including the Internet) are and how they work • Apply troubleshooting strategies to identify and fix problems • Use documentation and other resources to guide tasks
PREPARING FOR THE FUTURE	• Explore pathways and careers that involve computing • Apply computing concepts to other academic disciplines • Examine how emerging technologies are impacting a variety of practices • Evaluate the use of emerging technologies • Plan how an emerging technology could meet a need

IMPACTS AND ETHICS

INCLUSIVE COLLABORATION

HUMAN-CENTERED DESIGN

COMPUTATIONAL THINKING

+

DISPOSITIONS:

- Persistence
- Reflectiveness
- Creativity
- Curiosity
- Critical thinking
- A sense of belonging in computing
- Resourcefulness

AI within Foundational High School CS Content

ALGORITHMS	• **Define *algorithm*, including traditional an** • Compose, modify, and interpret algorithms • Decompose a problem into multiple subpr • Evaluate aspects of different algorithms
PROGRAMMING	• **Convert an algorithm to code** • **Modify a program** • **Articulate whether a program solves a given p** • **Systematically test and debug a program**
DATA AND ANALYSIS	• **Describe, at a high level, the role of data in A ML applications** • **Manipulate (e.g., normalize, transform, clean) ata** • Trace how data moves through a program • Evaluate data visualizations • **Work with large data sets**
COMPUTING SYSTEMS AND SECURITY	• Identify various types of hardware and softwar • Describe why/how cybersecurity is important • Explain what networks (including the Internet) re • **Apply troubleshooting strategies to identify nd** • **Use documentation and other resources to guide tasks**
PREPARING FOR THE FUTURE	• **Explore pathways and careers that involve computing** • **Apply computing concepts to other academic discipline** • **Examine how emerging technologies are impacting a variety of practices** • **Evaluate the use of emerging technologies** • **Plan how an emerging technology could meet a need**

societal impacts of AI (e.g., biased data, attribution)

using AI to generate code, then reading, modifying, debugging

emphasis on data fluency, understanding use in ML

prompt engineering; evaluating outputs for biases, accuracy

IMPACTS AND ETHICS

INCLUSIVE COLLABORATION

HUMAN-CENTERED DESIGN

COMPUTATIONAL THINKING

DISPOSITIONS:

- Persistence
- Reflectiveness
- Creativity
- Curiosity
- Critical thinking
- A sense of belonging in computing
- Resourcefulness

Pathways

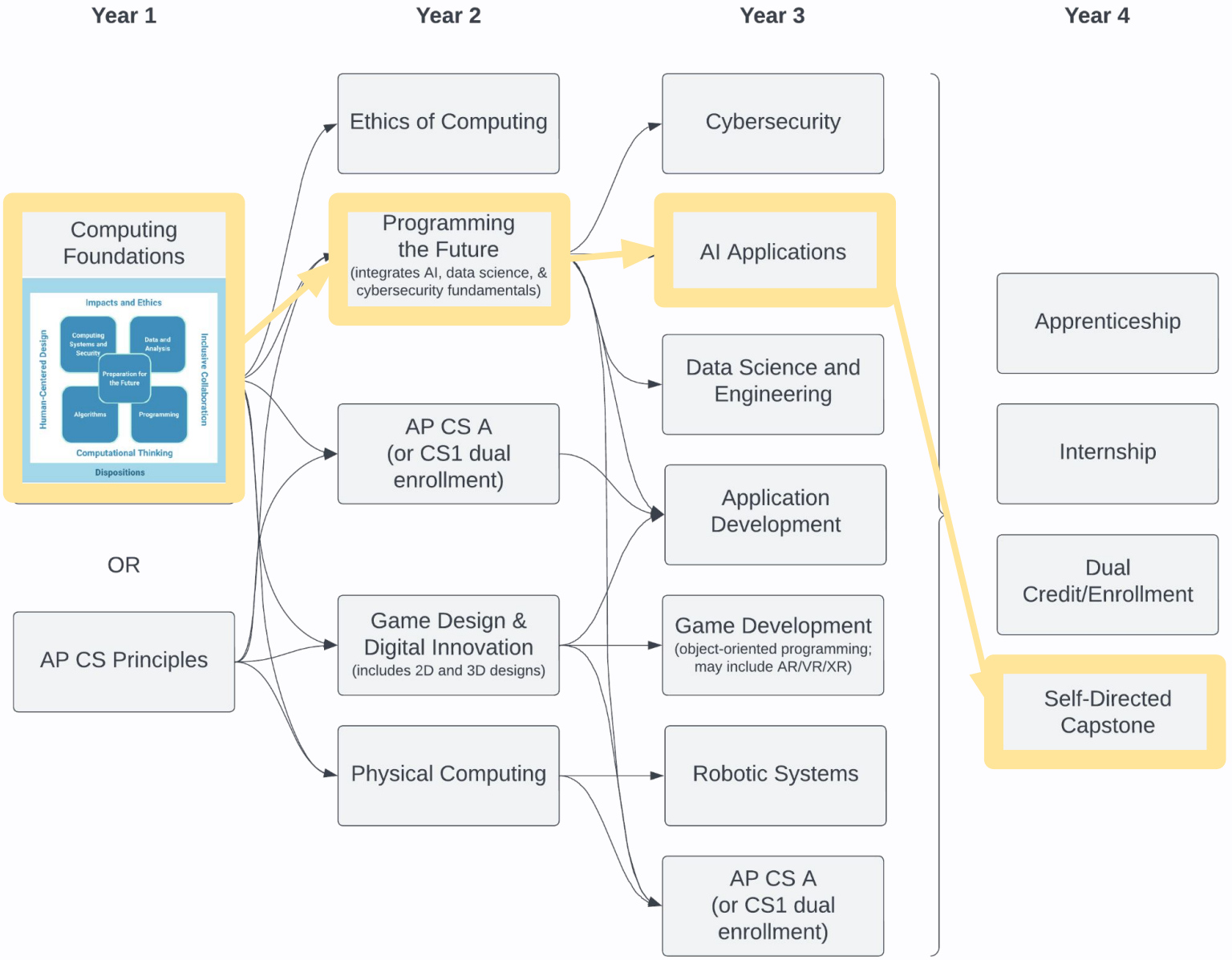
for continued CS learning beyond the foundational content

AI Content Progression

Foundational Content	Fundamentals	Specialty	Careers
• How algorithms are used • Difference between traditional and AI/ML algorithms, including the role of data in AI/ML • Patterns/commonalities in problems, data, and programs • Evaluate outputs for biases and accuracy • Societal impacts of AI (e.g., biased data, attribution) • Basic data formats and metadata • Cleaning data • Visualizing data • Impact of emerging technologies	• What is AI: history, levels of AI, future careers • Intro to AI programming and intro to prompt engineering • Natural interaction, semantics, chatbots • Representation and reasoning, KNN, vectors • AI programming (project), using AI tools to solve problems • Ethical frameworks, philosophy, psychology, bias • Sensors, perception, classification • Using datasets, regression, probabilistic thinking • CNN, decision trees, bias • Return to ethical design and empathy interviews	• Fundamentals of electronics, mechanisms, circuits, gears, sensors • Computer vision, sensor applications, models, perceptions • Robot hardware manipulation (or software simulators) • Using data: collection, cleaning, data types, validity, bias • Machine learning (ML) models: optimization, accuracy, decision making, ethical considerations • Linear algebra, matrices, vectors, probability, statistics • Programming applications with math • Biases in data collection, analysis, and reporting • Data visualization	• Machine Learning Engineer • Data Scientist • AI Research Scientist • Computer Vision Engineer • Natural Language Processing Engineer • Robotics Engineer • AI Ethics and Policy Analyst • Autonomous Vehicle Engineer • AI Cybersecurity Engineer

summary of what we just reviewed (i.e., AI within the foundation)

Model Course Pathways at a Glance



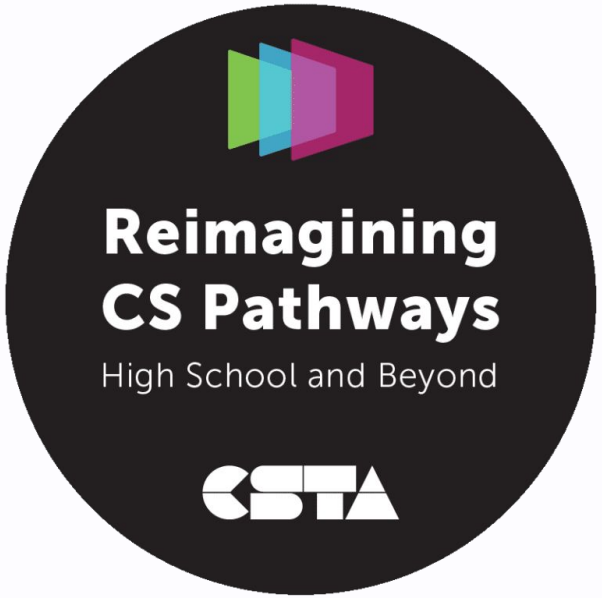
CSTA K-12 Standards Revision Process

2024				2025				2026			
Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
<< Research											
<< Reimagining CS Pathways											
	K-12 Standards Comparison										
		Literature Review									
		Writing									
		Writing Teams and Advisory Teams Meet Regularly									
				Feedback		Feedback		Feedback			
								Implementation			>>
										Publish	
								Supplementary Resource Development			

Please apply to be a writer, advisor, or reviewer by June 17!

Coming Soon!

Final report and products published in July 2024 at **ReimaginingCS.org**



Available now @ **csteachers.org/reimagining:**

- Interim Report 1: Foundational High School CS Content
- Interim Report 2: CS Content Progressions and Model Course Pathways

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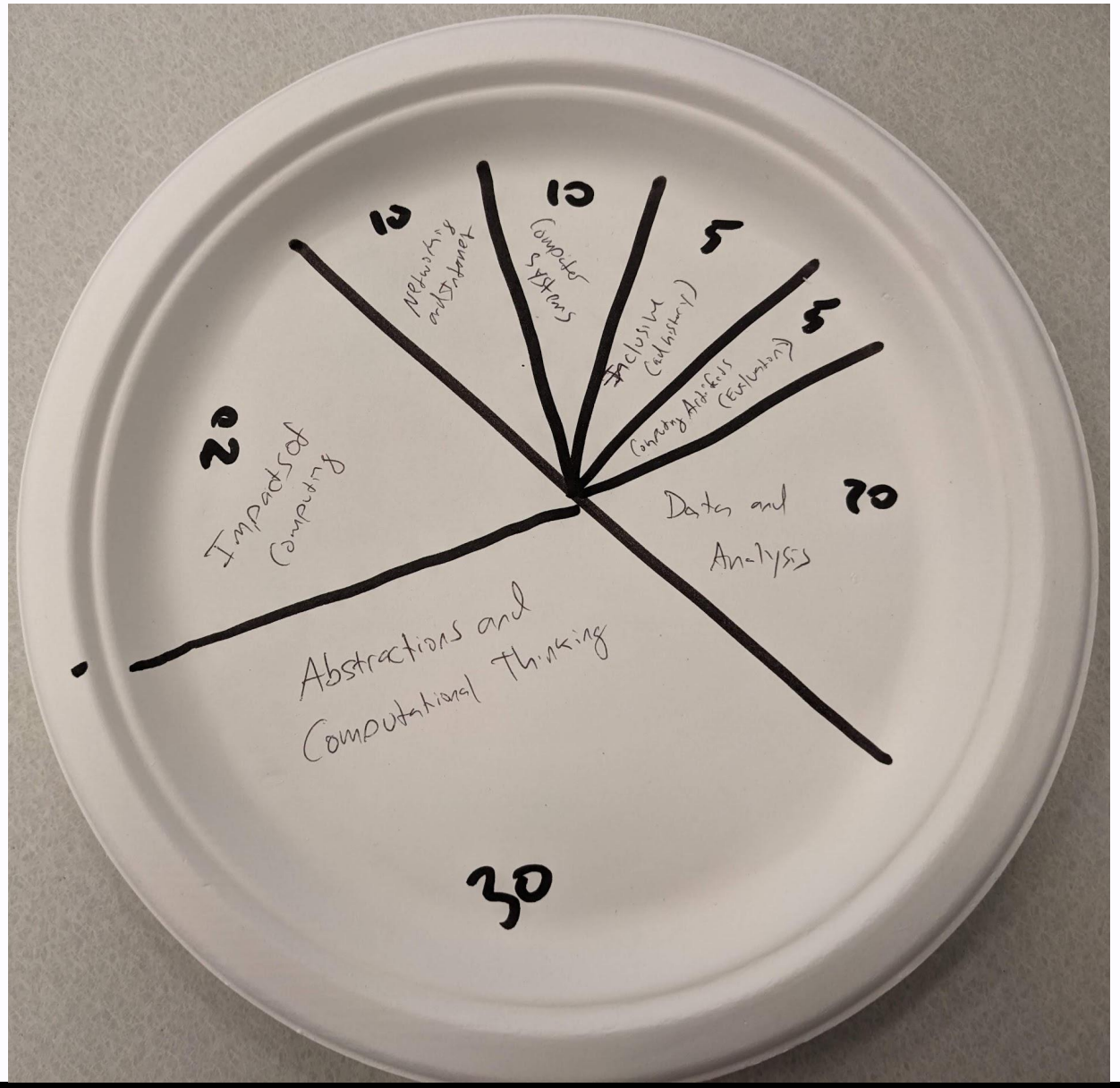
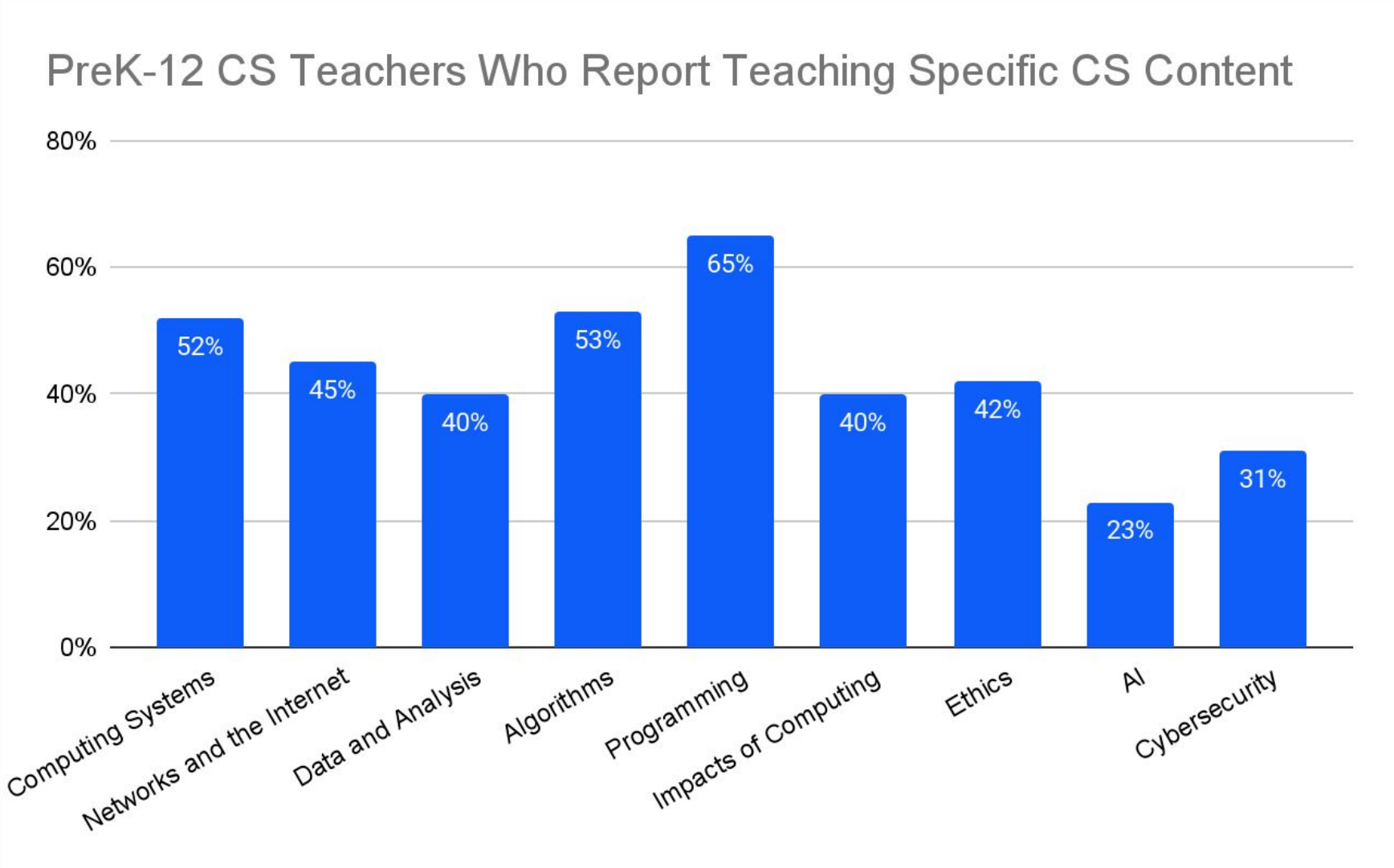

20
Impacts of Computing
12
Networks and Internet
13
Computer Systems
5
Collaboration
5
Creating Artifacts
20
Data and Analysis
1
Abstractions and Computational Thinking
30

Implementation is Inconsistent with Standards



Data is from the 2022 CS Teacher Landscape Survey (Koshy et al., 2023)

CS Teacher Beliefs About Teaching AI

81%

AI content should be explicitly included in the upcoming revision of the CSTA K-12 Standards.

50%

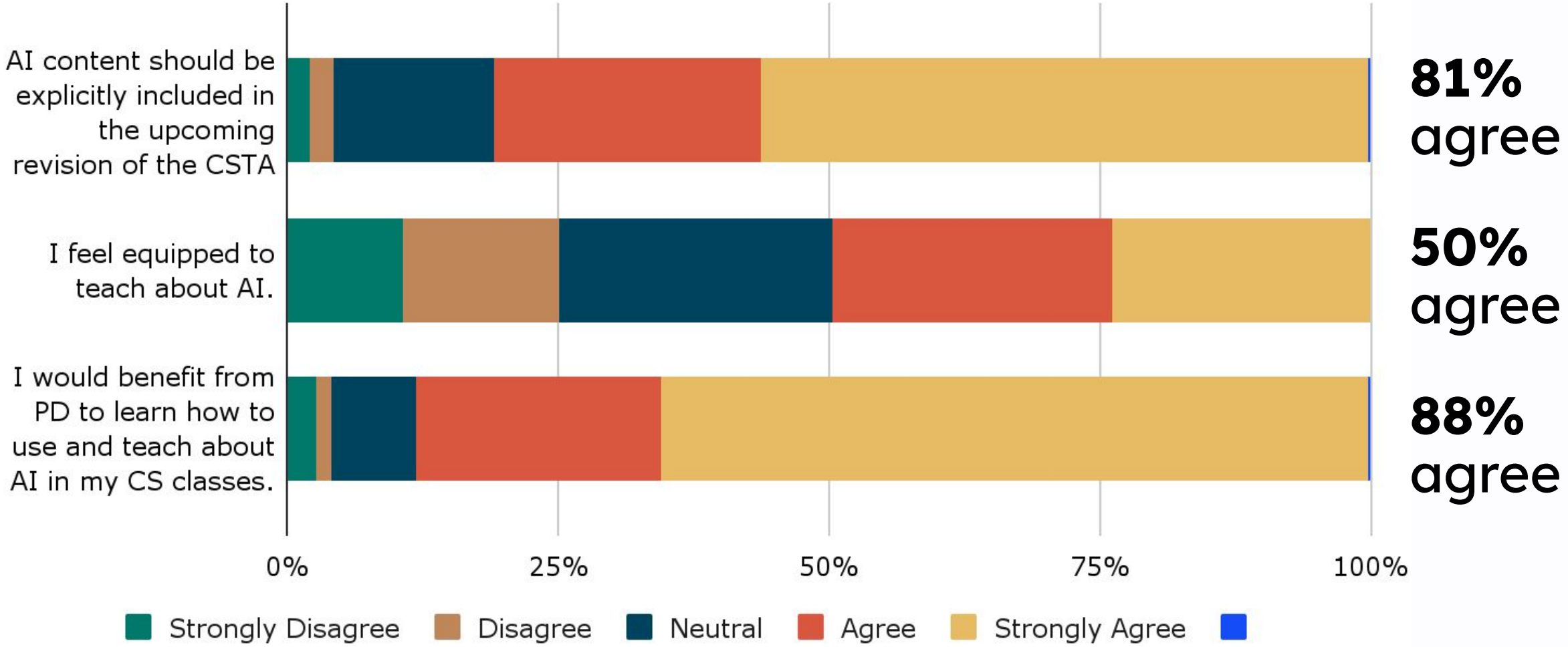
I feel equipped to teach about AI.

88%

I would benefit from PD to learn how to use and teach about AI in my CS classes.

Data is from an unpublished survey of K-12 CS teachers in the U.S. (CSTA & TeachAI, 2024)

K-12 CS Teachers' Beliefs about Teaching AI (N=394)



81% agree

50% agree

88% agree

Data is from an unpublished survey of K-12 CS teachers in the U.S. (CSTA & TeachAI, 2024)

Guidance on the Future of Computer Science Education in an Age of AI

1. **Is it still important for students to learn how to code?**
2. **How are teachers in CS classrooms already incorporating AI?**
3. **What ethical considerations and practices should students engage in to become critical consumers and responsible creators of AI?**
4. **What AI topics should be included in a fundamental CS experience?**
5. How might teachers in primary grades include AI in CS learning?
6. How can AI support students with disabilities to learn computer science?
7. How can AI be utilized to enhance student experiences for those who have been historically marginalized in CS?
8. How is AI being used in software development, and what can CS education learn from those experiences?
9. What core CS concepts and practices might be emphasized or deemphasized when we teach with and about AI?
10. How do we teach about AI in contexts with low technical infrastructure?

Some Thoughts on Your Challenge

- We currently have a crisis in public education, where teachers are not properly valued, prepared, supported, and retained.
- We haven’t yet recovered from the impacts of COVID.
- There are vast inequities in education, and specifically within CS education, that we must systematically address.
- Implementation is moving faster than research.
- Implementation is inconsistent with standards adoption.
- Most disciplinary instruction continues to be siloed.
- Integration is a promising approach, but unless we provide time and resources, teachers will be unable to integrate at scale.
- We continue to increase essential content, but schools already have an overfull plate. Something has to give.