entry points:

Pathways and Possibilities to Support Student Learning about Data and AI

EVENT #3 | National Frameworks and Recommendations

Sponsored by the College of Education, Health and Human Sciences at the University of Tennessee, Knoxville

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THE UNIVERSITY OF TENNESSEE KNOXVILLE

COLLEGE OF EDUCATION, HEALTH & HUMAN SCIENCES

Entry Points Presenters

K-12 Data Science Model Learning Progressions:
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Competencies for the Future of Data and Computing:
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ASA’s 2026 GAISE College Report:
Jamie Perrett & Patti Frazer Lock

01

Data and Computing in K–12

Data and Computing in K–12 Education

Foundational Competencies

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CADE Entry Points Webinar Series
National Frameworks & Recommendations • April 28, 2026

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About This Report

THE CHARGE

Identify the competencies needed for students to navigate and succeed in the changing computational landscape and describe the role that K–12 education can play in the development of these competencies.

- What competencies are needed for basic literacy in data and computing?
- How are these competencies related to those in other STEM fields?
- What should learning experiences look like in practice?
- What are the implications for K–12 curricula?

Key Takeaways

Avoid Overwhelming the System

Recent calls to add computer science, data science, AI, and quantum information science to K–12 could overwhelm schools if not done carefully.

Common Competencies Already Exist

Shared competencies undergird all these fields and are, to some extent, already present in K–12 curricula.

Multiple Entry Points, Starting in Kindergarten

Integrate into science and math classes, elevate data and computing learning goals, and provide stand-alone courses where appropriate.

The Seven Foundational Competencies

1	**Problem Posing & Problem-Solving Processes**	*Define, plan, attempt, reflect, and iterate*
2	**Producing & Working with Data**	*Produce, organize, explore, and visualize data*
3	**Abstraction, Algorithmic Thinking & Automation**	*Design systematic, step-by-step solutions*
4	**Probability & Inferential Reasoning**	*Reason under uncertainty; make inferences*
5	**Models & Representations**	*Construct, assess, and reason with models*
6	**Technology & Society**	*Ethics, values, and societal impacts*
7	**Data & Computing Systems**	*Tools, systems, access, and ownership*

Connecting to What Schools Already Teach

Mathematics & Statistics

- Measurement and number sense are precursors to working with data (NCTM, Common Core, GAISE)
- Solving equations builds algorithmic thinking
- Probability and statistics connect directly to inferential reasoning
- Mathematical modeling aligns with models and representations

Science & Engineering

- Analyzing and interpreting data is a core Next Generation Science Standards (NGSS) practice
- Planning investigations connects to data production
- Developing and using models is central to science
- Computational thinking is already in the “Framework for K–12 Science”

Starting in kindergarten, students can gradually build more sophisticated knowledge of data and computing.

Effective Learning Experiences

Meaningful & Relevant

Leverage students' prior knowledge and lived experiences; connect to daily life and communities.

Unplugged & Digital

Hands-on, screen-free activities build conceptual understanding; digital tools enable sophisticated analysis.

Increasing Complexity

Start in elementary school; build sophistication through middle and high school, whether integrated or stand-alone.

EXAMPLE K–5 students use unplugged sorting activities to explore algorithmic thinking; middle schoolers collect community data on air quality and use coding tools to visualize patterns; high schoolers build predictive models with real datasets and evaluate ethical implications.

Designing Curriculum for Data & Computing

PRIMARY APPROACH: Integration into Existing Subjects

- Elevate connections to data and computing already present in math, science, and other subjects
- Make data and computing goals explicit in lesson design
- Start in kindergarten and build throughout K–12
- Helps students see connections across disciplines

Stand-Alone Courses

- Available to all students
- Most appropriate in high school
- Complement, not replace, integration

WHAT THIS LOOKS LIKE IN PRACTICE

K–5

Kindergartners survey classmates on "What is your favorite food?" across cultures, categorize and graph responses — data production and problem-solving in math.

6–8

Students use agent-based modeling (StarLogo Nova) in science to simulate ecosystem dynamics, combining data collection, algorithmic thinking, and models.

9–12

Students program in Python to wrangle 150 years of NOAA climate data, visualize CO_2 trends, and answer their own research questions about temperature.

Recommendations for Action

Adding Data & Computing to K–12

- **Integrate** into existing subjects across all grades
- Start in kindergarten, build sophistication over time
- Stand-alone courses available to all, especially in high school
- Evaluate impact on graduation requirements

Supporting Teachers

- **Develop** instructional materials for unplugged and digital experiences
- Context-specific professional development
- Preservice preparation with data & computing
- Partner with CS and data science departments

Transforming the System

- **Coordinate** among initiatives and organizations
- Ensure access to tools for all students
- Measure student participation and outcomes
- Investment not tied to proprietary technology

Getting Started: Entry Points for Educators

Identify Connections

Look at your existing lessons. Where are data and computing already present? The competencies table can serve as a lens for finding these touchpoints.

Make It Explicit

When students collect data in science or solve equations in math, name the data and computing skills they're developing. Elevate what's already there.

Start Unplugged

You don't need technology to teach these competencies. Sorting activities, paper-based data investigations, and hands-on modeling are powerful starting points.

Collaborate Across Disciplines

Work with colleagues in other subjects to design integrated experiences. The competencies are cross-cutting by design.

Thank You

Download the full report for free (login required)

nationalacademies.org/data-computing-ed

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Competency 1: Problem Posing and Problem-Solving Processes

Students define a problem or question, identify the steps necessary to address it, make an attempt to answer it using tools, reflect on the process, decide on next steps, and iterate.

- Define a problem or question
- Identify the steps needed to address the problem or question
- Reflect and iterate

Competency 2: Producing and Working with Data

Students can both produce data and assess data quality, organize and prepare data for a variety of purposes, and explore and visualize data to begin to answer a question or problem.

- Produce data: measurement and data provenance
- Organize data: case/attribute structure and data moves
- Exploration and data visualization

Competency 3: Abstraction, Algorithmic Thinking, and Automation

Students deepen their skills of abstraction and logical reasoning to design and express solutions to problems in a systematic, step-by-step way, and to explore concepts and methods of automating data and computing processes.

- Creating abstractions in different contexts and applying them in programming
- Developing algorithmic thinking for different problems and small and large scales
- Recognizing, creating, and utilizing automated solutions for problem solving

Competency 4: Probability and Inferential Reasoning

Students identify sources of variability and uncertainty, develop probabilistic understanding, carry out statistical investigations and inference using formal testing procedures, and interpret and generalize results as appropriate.

- Identify sources and impacts of uncertainty and variability
- Recognize the roles of probabilistic, statistical, and deterministic reasoning and apply them in the context of models and applications
- Make inferences and predictions with appropriate degrees of certainty

Competency 5: Models and Representations

Students construct and reason with models and representations to explore phenomena and solve problems. They choose appropriate models for the situation and data available, assess the limitations of models and representations, and recognize the uncertainty inherent in any modeling activity.

- Construct and use models and representations
- Assess the quality of models and representations
- Recognize limitations of all representations and models

Competency 6: Technology and Society

Students recognize, anticipate, and address tensions related to technology and society, values, ethics, and responsibilities.

- Reasoning about process (how a task is accomplished) and product
- Reasoning about self and society

Competency 7: Data and Computing Systems

Students develop deeper awareness of data and computing tools and systems that provide a foundation to solve more complex problems and address future changes.

- Recognizing elements of data and computing systems
- Selecting and using data and computing systems
- Ownership, openness, and access

What's Next (Research Agenda)

- What progressions support increasing sophistication with data and computing tools (unplugged → blocks → text-based)?
- What is a coherent and developmentally appropriate sequence for teaching technology, ethics, and society?
- What are effective professional development models for integration into STEM and non-STEM disciplines?
- How should we measure student learning and achievement in data and computing?
- What would a "modern" math curriculum look like with increased emphasis on data and computing?

The report includes a full research agenda to guide future work in data and computing education.

02

K-12 Data Science Model Learning Progressions

Entry Points: National Frameworks

K-12 Data Science Model Learning Progressions

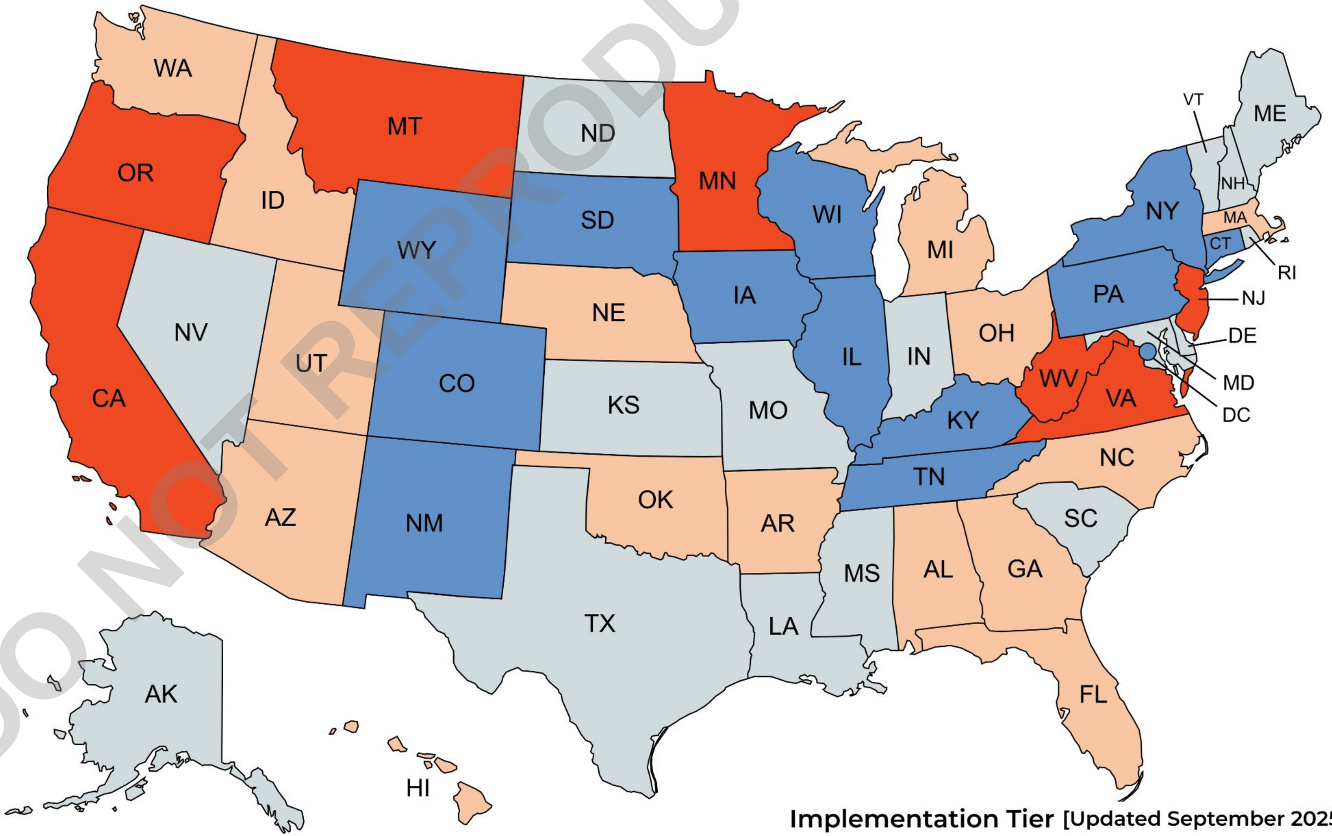
Field Landscape

State Implementation Examples

Tier 3 - Standards or Framework Adoption

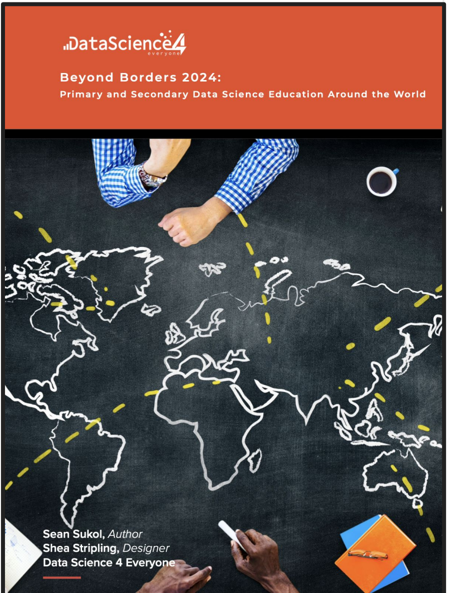
Tier 2 - Course Pilot, Course Sequence or Teacher PD

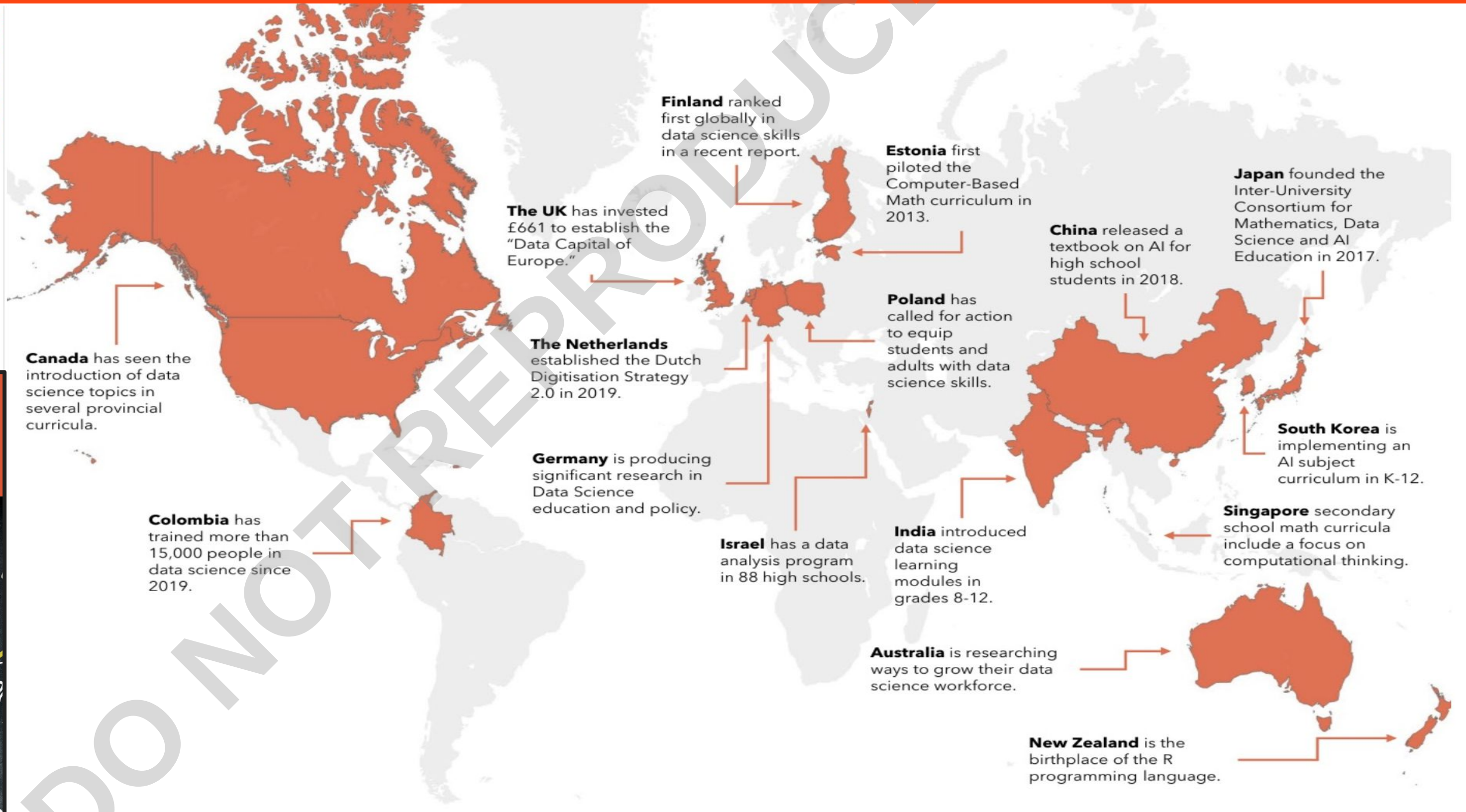
Tier 1 - Added to State Course Catalog



Implementation Tier [Updated September 2025]

DS4E Beyond Borders Report





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A National Learning Progression

A Practitioner-Led Movement for Data Education:

A Joint Position of NCTM, NSTA, ASA, NCSS, and CSTA

Our Position

Data science bridges disciplines and thus should be introduced and taught across the curriculum in K-12 schools to help develop informed users of data. Data science captures the complexity of data and data methods that have arisen with advances in technology, including breakthroughs in artificial intelligence. It is a collaborative science that uses complex data and methods to explain trends and patterns with a critical piece being its interdisciplinary nature. K-12 education plays the critical role of scaffolding students' experiences in addressing complex data sets. All subjects in school should recognize the contribution of data to their discipline and take curricular approaches that integrate data with disciplinary lessons where appropriate.

Introduction

Data can be numbers, counts, and measurements but also images, video, sounds, or words. Students need to grapple with the fast-changing nature of data, yet a gap exists between the concepts taught in math and the data skills needed by other disciplines. All learners need opportunities to develop data literacy, knowledge, and skills.

Different disciplines may have different concepts of data and have different analysis techniques that have been developed for their specific needs. However, the approach to working through a problem and answering questions with data are consistent themes in practices used across all disciplines (Reynante et al., 2020; National Academies of Sciences, Engineering, and Medicine, 2023). Data science tools and practices can help students learn with and through data to make meaning of phenomena and issues across disciplines. A data-enabled approach affords students an opportunity to bring their personal interests, histories, cultural identities, and self into classrooms where learning is connected to their real world (e.g., Louie et al., 2021; V. Lee, Wilkerson, & Lanouette, 2021).

Building from the practices of data scientists who use data to solve real world problems, H. Lee et al. (2022) proposed

NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS

Teaching Data Science in High School: Enhancing Opportunities and Success

Ensuring that all students have the mathematical experiences necessary to increase their opportunities for personal and professional success is essential. Data science is a rigorous, engaging, and practical field of study and can be a significant part of a high school student's mathematical experience. Knowledge of data science is important, and a data science course should be accepted as a high school mathematics course that can be used for credit towards graduation, provided the course includes or builds on previous, substantive student work with essential concepts, knowledge, skills, and habits of mind in mathematics and statistics, as described in Catalyzing Change (NCTM, 2018).

Introduction

Data science captures the complexity of data and data methods that have arisen with advances in technology. It is a collaborative science that uses complex data and methodology to identify and explain trends and patterns in a particular context. Since data science bridges disciplines, it should be taught across the curriculum. Because of the structure of most high schools, data science courses will likely reside in mathematics departments.

The continual and rapid increase in the capacity of technology to collect, organize, and manage data compels educators to prepare students to live in this world "awash in data" (Erickson, 2017). Students should become familiar with data science, a field that is quickly changing and evolving. Every second of every day, the world creates enough data to fill 50 new libraries of Congress (Domo, n.d.).

It is essential that students understand data so that they can comprehend the massive amounts of information that they encounter on a regular basis, and is available at their fingertips. High-quality experiences working with data expose students to new and different kinds of content that can energize and motivate them and enable them to see many uses for mathematics to make sense of the world around them.

Declarations

- All students should have the opportunity to take four years of high school mathematics, and data science content should be available to all students in order to complete their high school mathematics graduation requirement.

A Recent History of K-12 Data Science: 2013 - 2023

2013 – NSF grants fund curriculum, software research

2017 – Data Science Education Technology Conference (Concord Consortium)

2019 – IDSSP Framework Released

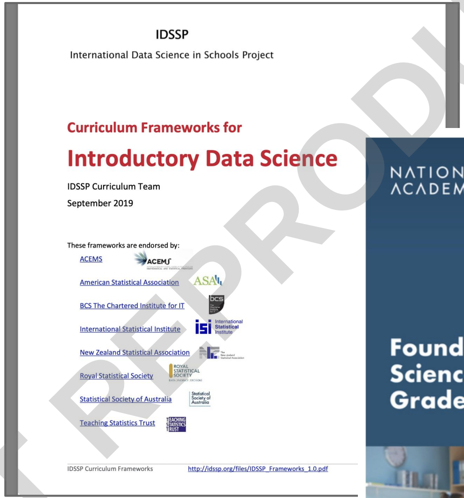
2020 – GAISE II Framework Released

2020 – National K-12 Summit at Stanford University

2021 – K-12 Technical Working Group (IES)

2022 – Foundations of Data Science Workshop (National Academies Workshop)

2023 – Data Science & Literacy Act introduced


IDSSP

International Data Science in Schools Project

Curriculum Frameworks for

Introductory Data Science

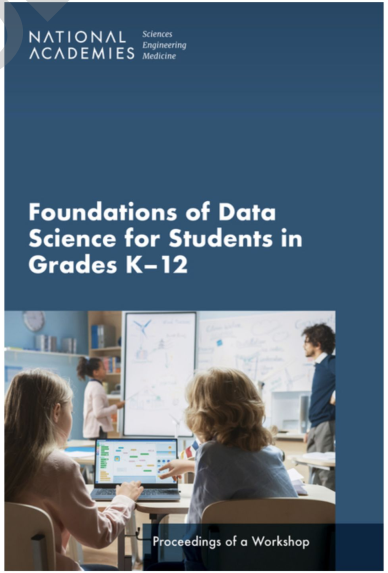
IDSSP Curriculum Team

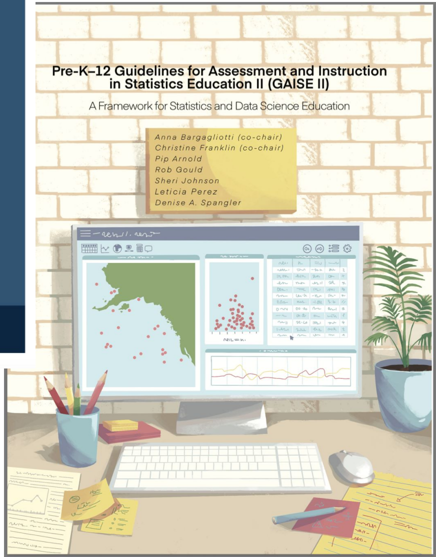
September 2019

These frameworks are endorsed by:

- ACEMS
- American Statistical Association
- BCS The Chartered Institute for IT
- International Statistical Institute
- New Zealand Statistical Association
- Royal Statistical Society
- Statistical Society of Australia
- Teaching Statistics Trust

IDSSP Curriculum Frameworks http://idssp.org/files/IDSSP_Frameworks_1.0.pdf





An Effort for National Learning Progressions

2024 – National Focus Groups: gather more robust prioritization input from the sector at-large

Educators - Math

NCTM

Educators - Science

nsta National Science Teaching Association

Educators - Social Studies

NCSS National Council for the Social Studies

Educators - Computer Science

CSTA

Industry

Northwestern Mutual Data Science Institute

Northwestern Mutual · Marquette University · UW Milwaukee

Higher-Ed (Math et al.)

TPSE Math – Transforming Post-Secondary Education in Mathematics

ASA

Higher-Ed (Undergrad Data Sci)

ADSA

Teacher Educators

AMTE

Policymakers

ASSM

Curriculum Providers

DataScience4everyone Providers Network

Students

Mr. Harding
Mr. Young-Saver

Educators - English

NCTE

DataScience4everyone

Prompt for National Focus Groups

A single question:

"If a hypothetical high school exit exam about data was given in 2030, what should be covered?"

Results: Narrowing

Month 1: *Drafting Grad. Outcomes*	327 Draft Learning Outcomes across all groups
Months 2-3: *Voting In-Group*	> 110 Top Learning Outcomes across all groups
Month 4: *Grouping + Convening*	> 25 Top Learning Outcomes for public voting
Month 6-8: *Public Voting*	> Ranked Learning Outcomes by high school graduation with national consensus

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Results: Aligning on Vision

Topic Group	Classification	Header Label	Content Outcomes. "Students should be able to..."	Focus Group	Normalized Points	Original Points	Notes
4	Skill(s)		(mixing probability, changing axes scales, correlation / causation, difference between mean / median, sampling bias / response bias, etc.) - ability to quickly recognize data manipulation	Students	1.222222222	11	assessr ones thi
4	Habit		Students will be able to **recognize how data can be manipulated, misrepresented, or reinterpreted by individuals** in the process of communication to others	Social Studies Teachers (NCSS)	1	6	
5	Header	**Producing and tailoring visualizations:**	**Deploy data visualizations relevant to the problem and audience**, including knowing which visualization technique is best for different types of data (categorical, numeric, different distributions, etc.), knowing a toolkit of visualization types (box-plots, histograms, other visual types, etc.), confidently leverage the most appropriate software tool (e.g. spreadsheets, PowerBI, Tableau, R-Shiny) for the task, instintively make data visuals accessible (e.g. alt-text, accessible colors), and design the visualization for the existing knowledge of their audience. *Examples may include students presenting survey data on school-lunches to their student council, who have not taken an introductory data science course, wherein categorical data could be arranged in a simple bar-chart. Rather than memorizing data visualization types, students would consider the type of data they have and their audience before building or coding a chart.*		5.069		
5	Skill(s)		Students **can generate and interpret data visualizations**: including what visualization technique is best for different types of data (categorical, numeric, different distributions, etc.) and types of visualizations themselves (box-plots, histograms, other visual types, etc.)	Science Teachers (NSTA)	1.214285714		
5	Skill(s)		**Data visualization techniques & analysis**: formalize and visualize the data so that it is geared to the target audience (i.e. used of tools like Power BI, Tableau) and tells a story about data, and question the story if appropriate, including knowledge of common visualizations such as chart, bar charts, pie charts, heatmaps, histograms, open source tools such as ggplots, and how to map data to the right type of visualization	Industry	1.136363636	12.5	Differen there cc (Valerie
5	Skill(s)		**Data visualization sense**: Create your own, make sense of, and use data visualizations that utilize color, size, share, location, motion, and sensory outputs (sound, smell, light, touch) - diverse data types are included. Use representations to communicate about the world.	Teacher Educators	0.9716666667		
5	Skill(s)		**Utilize accessible practices for visualizing and communicating about data**, including alt-text and plain-language / format	Students	0.7777777778		
5	Knowledge		...rtance, including to **recognize appropriate** ... **interpret them to identify trends, patterns,**	Higher-Education (all)	0.6777777778		
5	Skill(s)		...ation, and comfort using tools like Tableau or	Higher-Education (DS)	0.2916666667		

< How much the collective valued an outcome in aggregate.

< How much each group valued an outcome relative to others.

< How each group approached an outcome conceptually.

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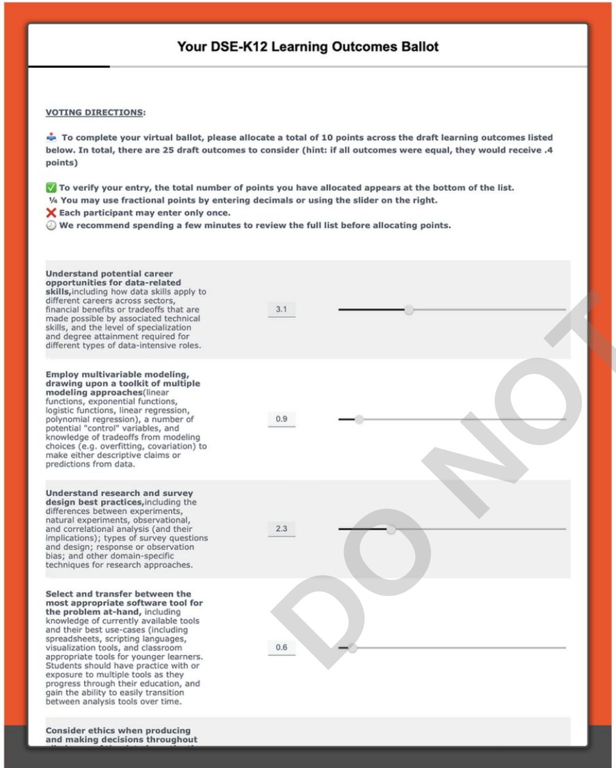
Chart The Course



Your DSE-K12 Learning Outcomes Ballot

VOTING DIRECTIONS:

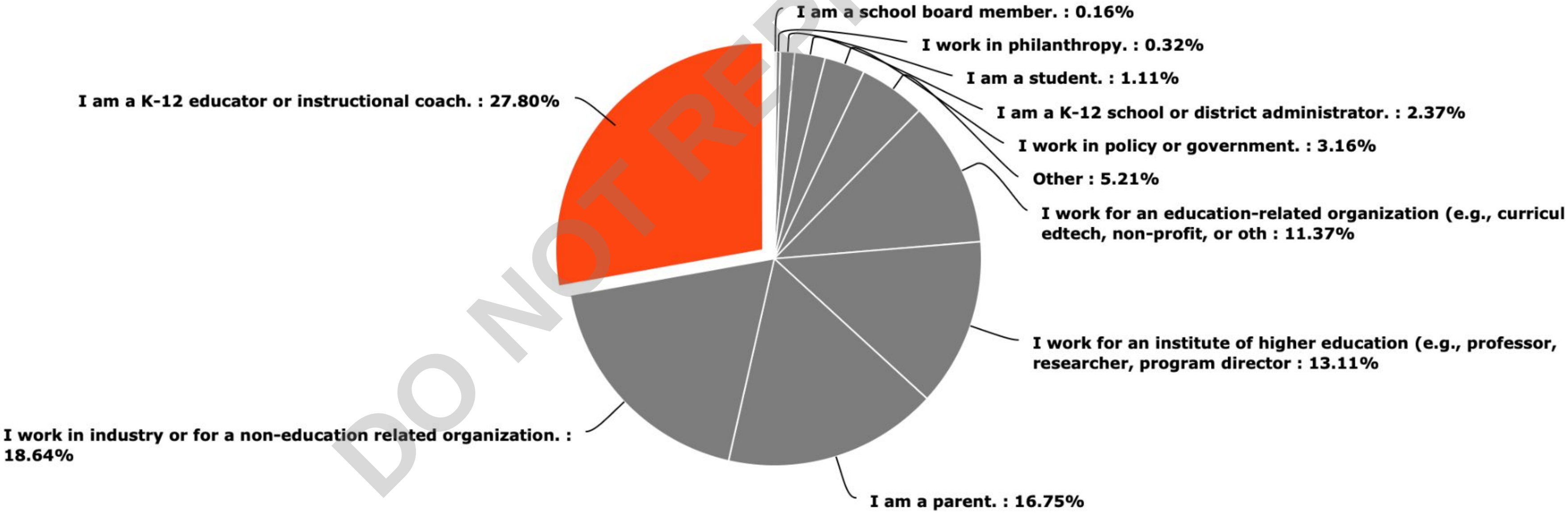
To complete your virtual ballot, please allocate a total of 10 points across the draft learning outcomes listed below. In total, there are 25 draft outcomes to consider (hint: if all outcomes were equal, they would receive .4 points)

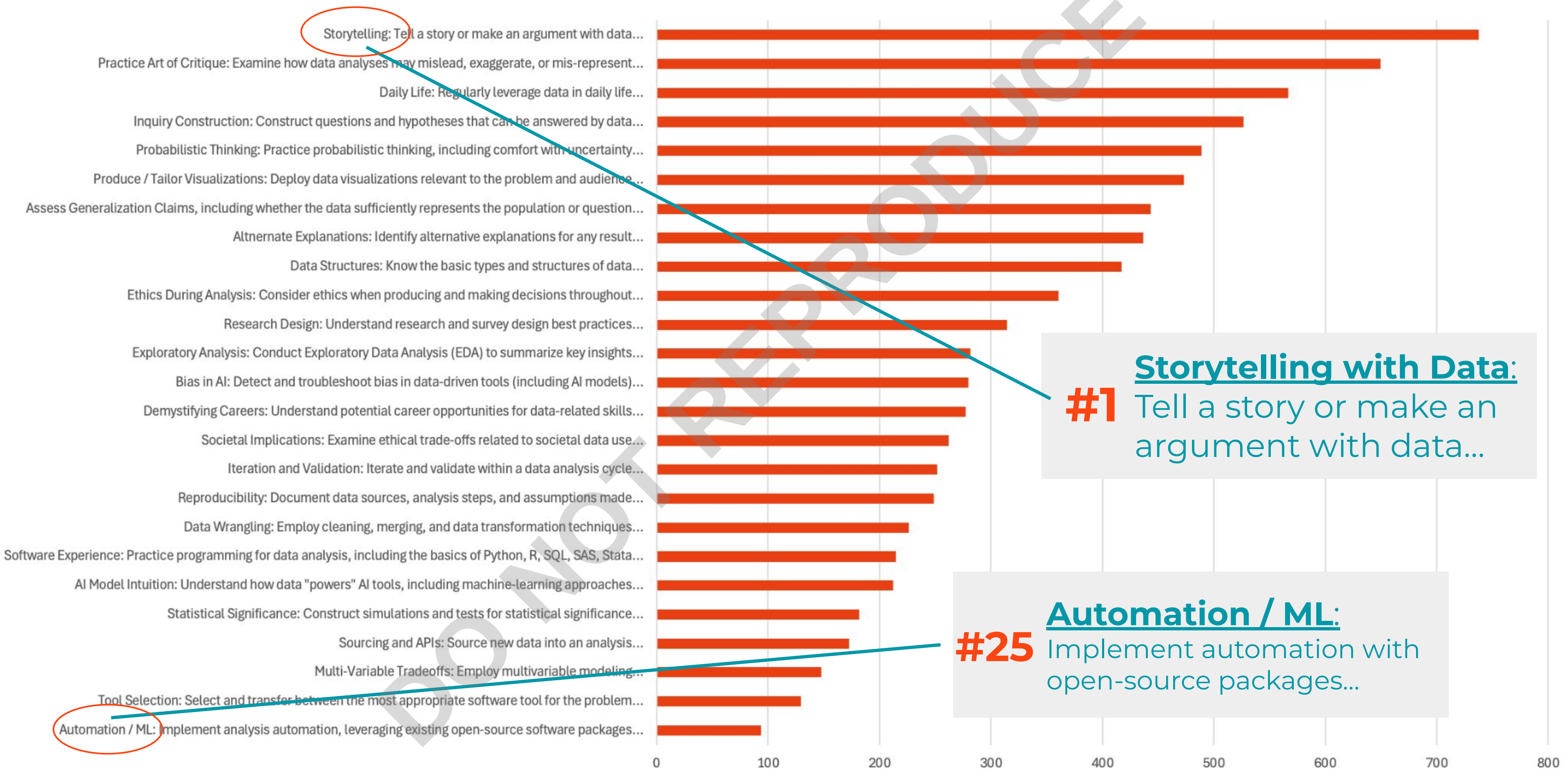
✅ To verify your entry, the total number of points you have allocated appears at the bottom of the list.
¼ You may use fractional points by entering decimals or using the slider on the right.
❌ Each participant may enter only once.
We recommend spending a few minutes to review the full list before allocating points.

Understand potential career opportunities for data-related skills, including how data skills apply to different careers across sectors, financial benefits or tradeoffs that are made possible by associated technical skills, and the level of specialization and degree attainment required for different types of data-intensive roles.	3.1
Employ multivariable modeling, drawing upon a toolkit of multiple modeling approaches (linear functions, exponential functions, logistic functions, linear regression, polynomial regression), a number of potential "control" variables, and knowledge of tradeoffs from modeling choices (e.g. overfitting, covariation) to make either descriptive claims or predictions from data.	0.9
Understand research and survey design best practices, including the differences between experiments, natural experiments, observational, and correlational analysis (and their implications); types of survey questions and design; response or observation bias; and other domain-specific techniques for research approaches.	2.3
Select and transfer between the most appropriate software tool for the problem at-hand, including knowledge of currently available tools and their best use-cases (including spreadsheets, scripting languages, visualization tools, and classroom appropriate tools for younger learners. Students should have practice with or exposure to multiple tools as they progress through their education, and gain the ability to easily transition between analysis tools over time.	0.6
Consider ethics when producing and making decisions throughout	

Chart The Course

Which of the following best describes your primary role?




Storytelling: Tell a story or make an argument with data...
Practice Art of Critique: Examine how data analyses may mislead, exaggerate, or mis-represent...
Daily Life: Regularly leverage data in daily life...
Inquiry Construction: Construct questions and hypotheses that can be answered by data...
Probabilistic Thinking: Practice probabilistic thinking, including comfort with uncertainty...
Produce / Tailor Visualizations: Deploy data visualizations relevant to the problem and audience...
Assess Generalization Claims, including whether the data sufficiently represents the population or question...
Altnernate Explanations: Identify alternative explanations for any result...
Data Structures: Know the basic types and structures of data...
Ethics During Analysis: Consider ethics when producing and making decisions throughout...
Research Design: Understand research and survey design best practices...
Exploratory Analysis: Conduct Exploratory Data Analysis (EDA) to summarize key insights...
Bias in AI: Detect and troubleshoot bias in data-driven tools (including AI models)...
Demystifying Careers: Understand potential career opportunities for data-related skills...
Societal Implications: Examine ethical trade-offs related to societal data use...
Iteration and Validation: Iterate and validate within a data analysis cycle...
Reproducibility: Document data sources, analysis steps, and assumptions made...
Data Wrangling: Employ cleaning, merging, and data transformation techniques...
Software Experience: Practice programming for data analysis, including the basics of Python, R, SQL, SAS, Stata...
AI Model Intuition: Understand how data "powers" AI tools, including machine-learning approaches...
Statistical Significance: Construct simulations and tests for statistical significance...
Sourcing and APIs: Source new data into an analysis...
Multi-Variable Tradeoffs: Employ multivariable modeling...
Tool Selection: Select and transfer between the most appropriate software tool for the problem...
Automation / ML: Implement analysis automation, leveraging existing open-source software packages...
0
100
200
300
400
500
600
700
800
#1
Storytelling with Data:
Tell a story or make an argument with data...
#25
Automation / ML:
Implement automation with open-source packages...

What did voting actually accomplish?

Top 25 Auditing_V2 January Edits

File Edit View Insert Format Data Tools Extensions Help

Header Label	Content Outcomes. "Students should be able to..."	Bucket	Normalized Points Focus Groups	Normalized Points Chart the Course	Total Points Chart the Course	LP Coverage Strand (ranked)	LP Co
Storytelling:	**Clearly tell a story or an argument with data**, including with effective presentation and speaking skills, the ability to write about a data analysis with plain-language vocabularly and any additional problem-speciifc terms, the ability to adapt to different audiences technical and non-technical audiences, necessary caveats and limitations of the analysis, a clear explanation for "why" their audience should care, and multiple representations of the data relevant for individual arguments (visualzations, summary statistics, process or methdology descriptions, etc.)	Communi...	7.189	7.8477	784.77	Strand E - Communication & ... Strand D - Interpreting Probl... Strand C - Analysis & Modeling	C - Ar D - Ur D - Re D - Ite D - M E - Ma E - Re E - W E - Re
Art of critique:	**Practice the art of critique for how data analyses may mislead, exagerate, or mis-represent**, including changing axes scales, inflated data graphics, mis-communicating correlation vs. causation, confusing the difference between mean / median, creating an intetional response bias via survey question design, failing to include controls, overfitting a model, and many other examples. Students should regularly seek other sources of information, knowing that any one analysis may be flawed or that quantitative data may not tell the full story. *In a classroom example, a student may learn the "data tricks" of misrepresentation and then be asked to identify them in the media for a homework assignment.*	L - Q / Cri...	3.285	6.72325	672.325	Strand A - Data Literacy & R... Strand E - Communication & ... Strand D - Interpreting Probl...	A - Da A - Co A - Us D - Ur D - Ite D - Co D - Ap E - Re E - Ci E - Re
Daily Life Integration:	**Regularly leverage data in daily life**, including to inform personal decision-making, address societal or community problems, or create solutions for others. *Examples may include leveraging spreadsheets to compare investment or healthcare options, examining data as a "first impulse" to make a policy or civic argument, or helping others solve a difficult problem by sourcing data on an unkown or tricky phenonmenon.*	Data Liter...	5.542	5.84885	584.885	Strand A - Data Literacy & R... Strand D - Interpreting Probl... Strand E - Communication & ...	A - Inv A - Inf A - Da A - Us A - Da D - Pr D - Ex E - St
Hypothesis construction:	**Construct questions and hypotheses for data analyses** that can be answered by data, including a clear hypothesis or set of hypotheses, an analysis plan for individual or collaborative tasks, a draft plan to source or gather additional datasets that may be needed. All analysis plans should be deeply rooted in the domain or context of the question. Questions should be authentic and ideally student-driven in project-based formats that introduce new methods as needed. *Classroom examples could include the creation of formal statistical hypothesis tests AND a collaborative project plan for task management within the same step.*	Interpreta...	6.504	5.5675	556.75	Strand A - Data Literacy & R... Strand D - Interpreting Probl... Strand B - Creation & Curation	A - Inv A - Inf B - Cr B - Pl D - Te D - Re

› Voting provided a rubric for the final version (we even audited!).

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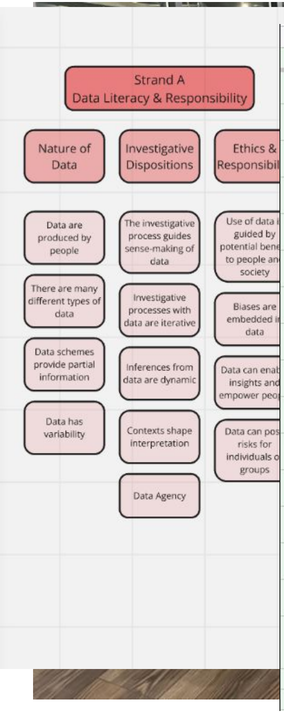
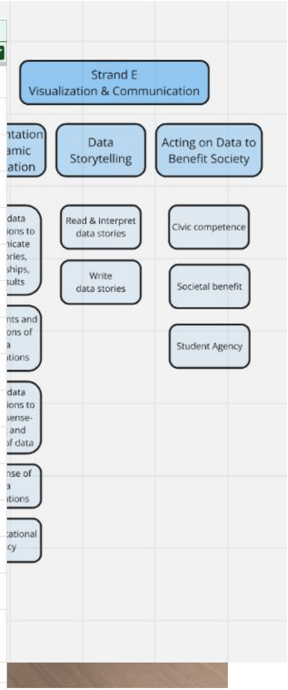
Writing Sprint



	A Grade-Level	B Sub-Strand	C Concept Name	D Students can...	E Research Reference(s) (hyperlink)
19	11-12	Data Ethics & R...	**Data can pose risks for individuals or groups**	Recognize that data risk can change based on time, circumstance, and purpose.	Algorithms of Oppression: How Search Engines Reinforce Racism, Noble, S., 2018
20	K-2	Data Ethics & R...	**Use of data is guided by potential benefit to people and society**	Recognize how data can be useful in understanding the world around us.	Enhancing Data Science Ethics Through Statistical Education and Practice, Utts, J., 2021
21	3-5	Data Ethics & R...	**Use of data is guided by potential benefit to people and society**	Evaluate data schemes and data creation based on potential benefits.	Enhancing Data Science Ethics Through Statistical Education and Practice, Utts, J., 2021
22	6-8	Data Ethics & R...	**Use of data is guided by potential benefit to people and society**	Recognize and evaluate new directions based on data.	Enhancing Data Science Ethics Through Statistical Education and Practice, Utts, J., 2021
23	9-10	Data Ethics & R...	**Use of data is guided by potential benefit to people and society**	Identify potential spheres of benefit based on data.	Enhancing Data Science Ethics Through Statistical Education and Practice, Utts, J., 2021
24	11-12	Data Ethics & R...	**Use of data is guided by potential benefit to people and society**	Recognize that data benefits can appear well into the future and in unexpected ways.	Enhancing Data Science Ethics Through Statistical Education and Practice, Utts, J., 2021
25	K-2	Investigative Dis...	**Contexts shape interpretation**	Share data and interpretations with others.	A Call for a Humanistic Stance Toward K–12 Data Science Education, Lee, V., Wilkerson, M., 2021
26	3-5	Investigative Dis...	**Contexts shape interpretation**	Recognize differences of data interpretation with respect to social and cultural contexts.	A Call for a Humanistic Stance Toward K–12 Data Science Education, Lee, V., Wilkerson, M., 2021
27	6-8	Investigative Dis...	**Contexts shape interpretation**	Explain data interpretations from various disciplinary and community perspectives (e.g., social studies, families)	A Call for a Humanistic Stance Toward K–12 Data Science Education, Lee, V., Wilkerson, M., 2021
28	9-10	Investigative Dis...	**Contexts shape interpretation**	Reinterpret data from multiple perspectives, disciplines, and historical frames of reference	A Call for a Humanistic Stance Toward K–12 Data Science Education, Lee, V., Wilkerson, M., 2021
29	11-12	Investigative Dis...	**Contexts shape interpretation**	Interpret data drawn from different fields and topics based on accepted norms within those fields.	A Call for a Humanistic Stance Toward K–12 Data Science Education, Lee, V., Wilkerson, M., 2021
30	K-2	Investigative Dis...	**Data Agency**	Develop data curiosity.	A Call for a Humanistic Stance Toward K–12 Data Science Education, Lee, V., Wilkerson, M., 2021
31	3-5	Investigative Dis...	**Data Agency**	Formulate questions that can be answered with data and statistical approaches.	A Call for a Humanistic Stance Toward K–12 Data Science Education, Lee, V., Wilkerson, M., 2021
32	6-8	Investigative Dis...	**Data Agency**	Evaluate, select, and use tools to support investigation and interpretation.	A Call for a Humanistic Stance Toward K–12 Data Science Education, Lee, V., Wilkerson, M., 2021
33	9-10	Investigative Dis...	**Data Agency**	Utilize the tools and repertoires of data science to engage in personal and collective inquiry.	A Call for a Humanistic Stance Toward K–12 Data Science Education, Lee, V., Wilkerson, M., 2021
34	11-12	Investigative Dis...	**Data Agency**	Maintain accountability for claims and decisions to be appropriately informed by data.	A Call for a Humanistic Stance Toward K–12 Data Science Education, Lee, V., Wilkerson, M., 2021, thomas philip 2013 "big data" framework
35	K-2	Investigative Dis...	**Inferences from data are dynamic.**	Recognize that many inferences from data are possible.	Investigating Data Like a Data Scientist, Lee, H.,2022
36	3-5	Investigative Dis...	**Inferences from data are dynamic.**	Revision of inferences is part of the investigative process.	Investigating Data Like a Data Scientist, Lee, H.,2022



Subject Neutral LP

What's Inside?

Subject-Neutral Learning Progressions v 1.0

K-12 Data Literacy and Data Science

Model Learning Progressions

Introductory Read Me

Why New Learning Progressions?

Data has been called the "new oil" since 2006, and much has changed since then. Data – and the extent to which we can understand and use it – shapes nearly every aspect of our lives, from the decisions we make at home to the skills required in the workplace. Yet, as the need for data literacy rises, our K–12 education system has not kept pace. The gap between what our students learn in school and the skills they need to succeed in our data-driven world is widening. Data science education opens doors to higher education, high-paying careers, an engaged community, and a thriving democracy. This set of national learning progressions outline K-12 learning expectations, which include data literacy, fundamental data science techniques, and foundational concepts in Artificial Intelligence (AI).

Research has found that US businesses across industries and government agencies are facing a well-documented shortage of data-literate workers. Meanwhile, the foundational skills, knowledge, and habits required for understanding and working with data are slipping in K–12 education. Recent results from national assessments like the National Assessment of Educational Progress (NAEP) show a significant decline in students' performance in learning domains, including data analysis, statistics, and probability, that are foundational for data literacy. The US risks falling further behind as other nations are investing heavily in data science education pathways from primary through tertiary education.

Goals and Benefits of the Learning Progressions

The K-12 Data Literacy and Data Science Learning Progressions are designed to provide a springboard for education communities such as curriculum providers, state educational agencies, school districts, and education leaders when designing learning opportunities to engage and educate students with and about data. The progressions reflect four important lenses:

- *The Data Cycle:* There is a process to working with data that is sometimes cyclic, never linear. This process should become more sophisticated over time, and the

Strand B - Creation and Curation

This strand focuses on where data comes from and how it should be collected, organized, and formatted often complex and messy, and whether it is collected first hand, or retrieved second hand from an extern context of data collection matters and affects the nature of errors in data collection. The methods and de and its ability to answer different questions.

Substrand B1. Organization & Process

In order for data to be useful for analysis and visualization, it often needs to be organized and formatted in particular ways. processing or transforming the data through calculations and logic statements t

Concepts	K-2	3-5	6-8
B1.1 Data cleaning Identify and address data quality issues to ensure accuracy and reliability, progressing from simple error identification to using systematic approaches.	K-2.B.1.1a Recognize and explain missing data (e.g., a student was absent when data was collected) or data recording errors (e.g., "10" recorded as a "1") if possible.	3-5.B.1.1a Look through data to identify missing data and add additional cases or values for attributes if possible.	6-8.B.1.1a Informa anomalies and out distribution of data an informed decisi whether those cas be removed or filte analysis.
	K-2.B.1.1b Keep track of responses so that you can tell if everyone has been asked.	3-5.B.1.1b Look through data to identify unreasonable values or recording errors in data values and correct these if the correct values are known.	
B1.2 Organizing and structure Organize raw data into structured formats using categories, tables, and systematic recording methods.	K-2.B.1.2a Collect and record data on case cards, wherein each card represents a single case.	3-5.B.1.2a Collect and record data about an object or event with a few attributes on a case card (e.g., age, month of birthday, favorite color).	6-8.B.1.2a Use ca attributes or bins/g quantitative attribu dataset to restruct groups.
	K-2.B.1.2b Create categories from individual qualitative responses (e.g. categorize "scary things").	3-5.B.1.2b Collect and record data or reorganize data that may be in a different format (e.g., case cards) about an object or event with 1-3 attributes into a case and attribute table where each row is a case and column is an attribute. The first column should be an ID or label describing the case and columns should have headings or attribute names (e.g., Plant ID, Condition (sun or shade), height on day 1, height on day 8).	6-8.B.1.2b Make s use a dataset arra nested or hierarch
	K-2.B.1.2c Define the categories used to measure the qualities of an object (color, shape, etc).		

6th Grade - 8th Grade

Strand A - Data Literacy and Responsibility

This strand focuses on what data is and all of the ways students should think about and frame it as a concept and tool. The nature of data is complex, diverse, and humanistic. When engaging with data you must consider the form it takes, where it can come from, and what it can and should be used for. Working with data is non-linear and often raises new questions while seeking answers to others. Additionally the data process is influenced at all stages by the humans working with it which can lead to biases and concerns about ethics and responsibility. However, data can also be powerful for supporting the advancement of discovery or enactment of change.

Substrand A1. Nature of Data

The nature of data is complex, variably, humanistic, and often incomplete. Data can take many forms and may come from many different sources. Additionally, data is integral to the field of AI.

A1.1 Data types and sources Recognize that data can exist as quantitative, ordinal, categorical, and other values. Data also can be "nontraditional" forms such as graphical or other media.	6-8.A.1.1a Understand how the nature of categorical and numeric data determines how it can be analyzed and interpreted (e.g., categorical data cannot have a measure of centrality).
	6-8.A.1.1b Understand that quantitative variables may be either discrete or continuous
A1.2 Data are produced by people Recognize that data represent decisions about measurement and inclusion involving people who *are* and *are not* immediately present.	6-8.A.1.2a Ask questions regarding the origins of specific automated measures (e.g., webtracking, email metadata, Spotify).
	6-8.A.1.2b Recognize the limits of the information the data can provide and the story it can tell.
	6-8.A.1.2c Recognize that conclusions may need to be revised in the future as more knowledge and data become available.
A1.3 Variability of data Recognize that variability is a foundational component of data.	6-8.A.1.3a Make sense of the variability of data through an iterative process of refinement by questioning.
A1.4 Data provides partial information Recognize that data capture certain aspects of a target phenomenon or object in the world but do not represent it completely.	6-8.A.1.4a Specify ways that data provide incomplete information relative to the object being studied.
	6-8.A.1.4b Approach data and evidence-based claims with reasonable skepticism and apply the process of evaluating the validity of claims while remaining open-minded.
A1.5 Data & AI Recognize that data "fuels" AI, that AI can be compared to a function machine (math), algorithm (CS), or a prediction model (statistics) that relies on data to both operate and improve itself, and that AI tools can also be used to analyze complex data in research.	6-8.A.1.5a Describe in plain language how AI uses and builds upon data in multiple ways. Example: AI is a model (algorithm / function) designed for a particular use case (categorizing pictures, associating correlations between words in LLMs) that updates after observing many input-output pairs (automation with data). Identify how issues in data (bias, missing data, errors) can affect the output of an AI tool and the training of an AI tool from the input-output pairs it learns from.

Substrand A2. Data Ethics and Responsibilities

The data process is influenced at all stages by the humans working with it which can lead to concerns about ethics and responsibility. It is important when working with data to consider the use risks as well as the benefits. Data can be powerful for supporting the advancement of discovery or enactment of change.

A2.1 Data use risks and benefits Recognize that data can pose risks but also benefits for individuals and groups, and weigh its potential uses, limitations, and risks, including unintended consequences.	6-8.A.2.1a Describe how social groups can be inadequately represented by existing data and data schemes.
	6-8.A.2.1b Recognize that options and choices exist for data gathered about individuals and that what is collected or omitted has consequences.
A2.2 Biases in data Recognize all data contains bias but data collection and analysis methods can increase or mitigate the effects of biases.	6-8.A.2.2a Identify how biases in data affect inferences and questions.
A2.3 Power of data Recognize data is powerful and can be used to argue for and support certain claims and viewpoints	6-8.A.2.3a Identify how data are used to persuade decisions and make insights for a variety of matters (e.g. individuals, communities, fields of study) and examine specific examples from the real world (e. g., media, speeches, or presentations).

Structure and Scope of the Progressions

The initial draft of the K–12 Data Literacy and Data Science Learning Progressions are **subject neutral**. The K–12 learning progressions are designed to be integrated with and complement existing courses and learning standards.

STRANDS

Substrands

Concepts

Competencies → Grade Bands

STRANDS

DATA SCIENCE EDUCATION K-12

Strand A Dispositions and Responsibility
Strand B Creation and Curation
Strand C Analysis & Modeling Techniques
Strand D Interpreting Problems and Results
Strand E Visualization and Communication

Substrands

DATA SCIENCE EDUCATION K-12

Strand A Data Literacy and Responsibility		
A1. Nature of Data:	A2. Data Ethics and Responsibilities	A3. Investigative Dispositions
Strand B Creation and Curation		
B1. Organization & Processing	B2. Designing for Data Collection	B3. Measurement & Datafication
B4. Complexity of Data		
Strand C Analysis & Modeling Techniques		
C1. Summarizing Data	C2. Identifying Patterns and Relationships	C3. Variability in Data
C4. Digital Tools of Data Analysis	C5. Models of Data	
Strand D Interpreting Problems and Results		
D1. Making and Justifying Claims	D2. Problem Identification & Question Formation	D3. Generalization
Strand E Visualization and Communication		
E1. Representations & Dynamic Visualizations	E2. Data Storytelling	E3. Acting on Data to Benefit Society

Concepts

DATA SCIENCE EDUCATION K-12

Strand B Creation and Curation
B1. Organization & Processing: In order for data to be useful for analysis and visualization, it often needs to be organized and formatted in particular ways. Organization can include both procedural cleaning up of errors or mistakes and processing or transforming the data through calculations and logic statements to create new or summative measures.
B1.1 Data Cleaning Identify and address data quality issues to ensure accuracy and reliability, progressing from simple error identification to using systematic approaches.
B1.2 Organizing and Structure Organize raw data into structured formats using categories, tables, and systematic recording methods.
B1.3 Processing and Transformation Transform and manipulate data through sorting, grouping, filtering, and combining datasets.
B1.4 Summarizing Groups Calculate and analyze group-level statistics from detailed data to reveal patterns and relationships.

Competencies and Grade Bands

DATA SCIENCE EDUCATION K-12

Substrand C1. Summarizing Data Raw data often is not useful for answering questions, making claims, or telling a story. In order to derive understanding it is usually useful to have a summary of the data which provides measures of the centrality, spread, and shape of the dataset.					
Concepts	**K-2**	**3-5**	**6-8**	**9-10**	**11-12**
C1.1 Measures of center Analyze large datasets by measuring the "center." This starts with the concept of an average (mean) and expands to include measures like the median, emphasizing their appropriate use based on the context and data distribution.	K-2.C.1.1a Understand that categorical data doesn't have a measure of center.	3-5.C.1.1a Calculate simple summaries for groups such as the total and typical value (mode) for categorical data or the typical or average value (mean or median) for numeric data.	6-8.C.1.1a Describe measures of center(e.g., mean as the equal share, mode as the most frequently occurring variable, and median as the middle-ordered value of the data).	9-10.C.1.1a Identify appropriate ways to summarize quantitative or categorical data using frequency tables, graphical displays, and numerical summary statistics	11-12.C.1.1a Explore the sensitivity of the mean to outliers compared to the median.
	K-2.C.1.1b Describe the center of numeric data qualitatively using phrases like "most popular".		6-8.C.1.1b Explain what measures of center are useful for and their limitations.		11-12.C.1.1b Discuss instances when to use the mean or median based on the context and data distribution (e.g., skewed vs. symmetric distributions).

Subject-Neutral Learning Progressions v 1.0

K-12 Data Literacy and Data Science

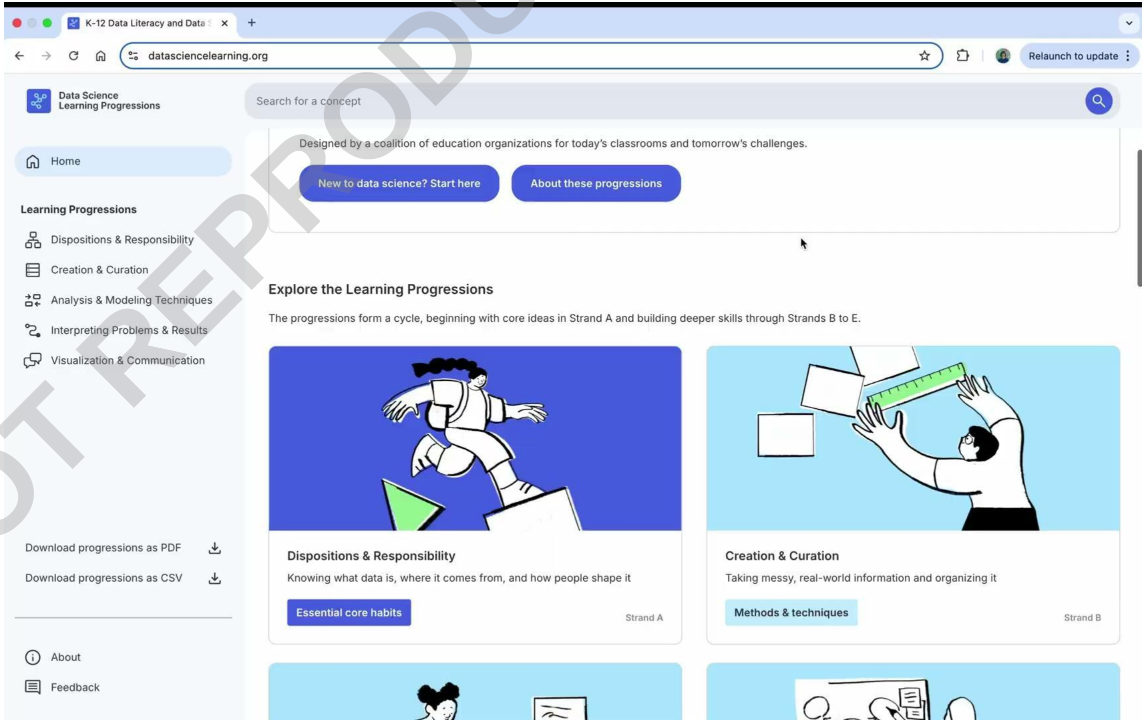
Model Learning Progressions

Intentional Gaps: our current best-guess, acknowledging we need more research in several areas:

Grade Band	Sub-Strand	Concept Code	Concept Name	Competency Code	Students can...	Reference(s) and Additional Reading(s)
3-5	Making and Justifying Claims	D1.1	Probablistic language	3-5.D.1.1a	Make a guess or hypothesis, and identify vocabulary to informally express the level of "confidence" or "degree of belief" in the guess to other students (e.g. "I believe most of my classmates go to school on the bus, and I "really" believe in my guess "strongly" because XX or YY").	Ben-Zvi, D., Aridor, K., Makar, K., & Bakker, A. (2012). Students' emergent articulations of uncertainty while making informal statistical inferences. ZDM – Mathematics Education, 44(7), 913–925. https://doi.org/10.1007/s11858-012-0420-3
6-8	Making and Justifying Claims	D1.1	Probablistic language	6-8.D.1.1a	State a hypothesis or finding and express the degree of certainty in writing with quantities (e.g. I am highly confident in this statement, as three separate sources estimate 60%, 65% and 62.3% of students in my area ride the bus." I have little reason to doubt these sources because XX.").	Groth, R. E., Bergner, J. A., & Burgess, C. R. (2019). Dimensions of learning probability vocabulary. Journal for Research in Mathematics Education, 51(1), 75–104. https://doi.org/10.5951/jresematheduc.2019.0008
9-10	Making and Justifying Claims	D1.1	Probablistic language	9-10.D.1.1a	State a result or finding, and clearly express the degree of certainty in writing in relation to a statistical device (e.g. distribution of the given data, a probability distribution, confidence intervals, hypothesis testing) and an informal "ballpark" or "gut-check" statement related to likelihood of the event.	Buck, Z. E., Lee, H.-S., & Flores, J. (2014). I am sure there may be a planet there: Student articulation of uncertainty in argumentation tasks. International Journal of Science Education, 36(14), 2391–2420. https://doi.org/10.1080/09500693.2014.924641
11-12	Making and Justifying Claims	D1.1	Probablistic language	11-12.D.1.1a	State a result or finding, and clearly express the degree of certainty in writing in relation to one or more statistical devices (e.g. distribution of the given data, a probability distribution, confidence intervals, hypothesis testing) and the quality of evidence (dataset characteristics, source characteristics, similar findings in alternative data) as a justification.	Buck, Z. E., Lee, H.-S., & Flores, J. (2014). I am sure there may be a planet there: Student articulation of uncertainty in argumentation tasks. International Journal of Science Education, 36(14), 2391–2420. https://doi.org/10.1080/09500693.2014.924641
Advanced Course	Making and Justifying Claims	D1.1	Probablistic language	**	State a result or finding, and clearly express the degree of certainty in writing in relation to two or more advanced statistical devices (e.g. probability distribution, t-tests / z-tests, bootstrapping / simulation) and the quality of evidence (dataset characteristics, source characteristics, similar findings in alternative data) as a justification.	
K-2	Making and Justifying Claims	D1.1	Probablistic language	K-2.D.1.1a	Recognize some situations are not binary / "black and white," and identify vocabulary to describe them (e.g. the way that my classmates get to school "may be" the bus versus "always is").	Makar, K., & Rubin, A. (2009). A framework for thinking about informal statistical inference. Statistics Education Research Journal, 8(1), 82–105. https://doi.org/10.52041/serj.v8i1.457
3-5	Making and Justifying Claims	D1.2	Priors and updates	3-5.D.1.2a	Record a guess or hypothesis before an investigation, compare the initial guess to findings, and informally express how the new data changes a prior guess.	Kazak, S. (2015). A Bayesian inspired approach to reasoning about uncertainty: 'How confident are you?'. HAL Archives Ouvertes.
6-8	Making and Justifying Claims	D1.2	Priors and updates	6-8.D.1.2a	Record a guess / prior assumption about the world, compare the initial assumption to findings from data, and assess the extent to which the original assumption should change in light of new evidence.	Tunstall, S. L. (2018). Investigating college students' reasoning with messages of risk and causation. Journal of Statistics and Data Science Education, 26(2), 76–86. https://doi.org/10.1080/10691898.2018.1456989
9-10	Making and Justifying Claims	D1.2	Priors and updates	9-10.D.1.2b	Relate prior assumptions about a problem or investigation to the degree of certainty in a given finding. Express this relationship in the vocabulary of "prior assumption," "new data / evidence," and "my updated assumption."	Tunstall, S. L. (2018). Investigating college students' reasoning with messages of risk and causation. Journal of Statistics and Data Science Education, 26(2), 76–86. https://doi.org/10.1080/10691898.2018.1456989
9-10	Making and Justifying Claims	D1.2	Priors and updates	9-10.D.1.2a	Recognize that the updated assumption should change somewhat, but might not need to change entirely, based on the degree of confidence in the new evidence.	Rosenburg, J. M., Lee, H.-S., & Flores, J. (2022). Making sense of uncertainty in the science classroom. Science & Education, 31(5), 1239–1262. https://doi.org/10.1007/s11191-022-00341-3
11-12	Making and Justifying Claims	D1.2	Priors and updates	11-12.D.1.2a	Identify how confirmation bias and availability bias (psychology) can affect how others or yourself consider new data, including the impact on someone's prior assumptions.	Cottone, A., Smith, T., & Johnson, L. (2022). High school science education in a "post-truth" society: Confronting confirmation bias with students and teachers.
11-12	Making and Justifying Claims	D1.2	Priors and updates	11-12.D.1.2b	Explain Bayes Theorem in informal ideas of conditional probability (probability of event, probability of event conditional on evidence being true, probability that evidence is true).	Rosenburg, J. M., Lee, H.-S., & Flores, J. (2022). Making sense of uncertainty in the science classroom. Science & Education, 31(5), 1239–1262. https://doi.org/10.1007/s11191-022-00341-3
11-12	Making and Justifying Claims	D1.2	Priors and updates	11-12.D.1.2c	Apply the logic of Bayes Theorem to determine whether a data-based claim in the media was accurately explained.	Alvarez-Arroyo, R. (2024). Probabilistic literacy and reasoning of prospective secondary school teachers when interpreting media news. ZDM – Mathematics Education, 56(3), 1045–1058. https://doi.org/10.1007/s11858-024-01586-8
Advanced Course	Making and Justifying Claims	D1.2	Priors and updates	**	In written conclusions from a data analysis, summarize prior assumptions and potential updates, and identify any known contradictory findings to mitigate confirmation bias.	Rosenburg, J. M., Lee, H.-S., & Flores, J. (2022). Making sense of uncertainty in the science classroom. Science & Education, 31(5), 1239–1262. https://doi.org/10.1007/s11191-022-00341-3
Advanced Course	Making and Justifying Claims	D1.2	Priors and updates	**	Explain Bayes Theorem in formal conditional probability statements: $P(A \mid B) = (P(A) * P(B \mid A)) / P(B)$, where A is the event in question and B is the event of new evidence related to A.	Rosenburg, J. M., Lee, H.-S., & Flores, J. (2022). Making sense of uncertainty in the science classroom. Science & Education, 31(5), 1239–1262. https://doi.org/10.1007/s11191-022-00341-3

Digital Platform

Data Science Learning Progressions



https://datasciencelearning.org/

DataScience4 everyone

Quick Introductions

A roadmap for teaching K-12 data science

Designed by a coalition of education organizations for today's classrooms and tomorrow's challenges.

New to data science? Start here | About these progressions | Explore the blog

Explore the Learning Progressions

What's Next 5 min read

What's next for these learning progressions

See how data science connects to your subject, with subject-specific progressions coming in 2026.

Getting Started 5 min read

Five basic concepts for teachers new to data science

Not sure where to start with data science? Good news – you're probably already practicing more data science than you realize.

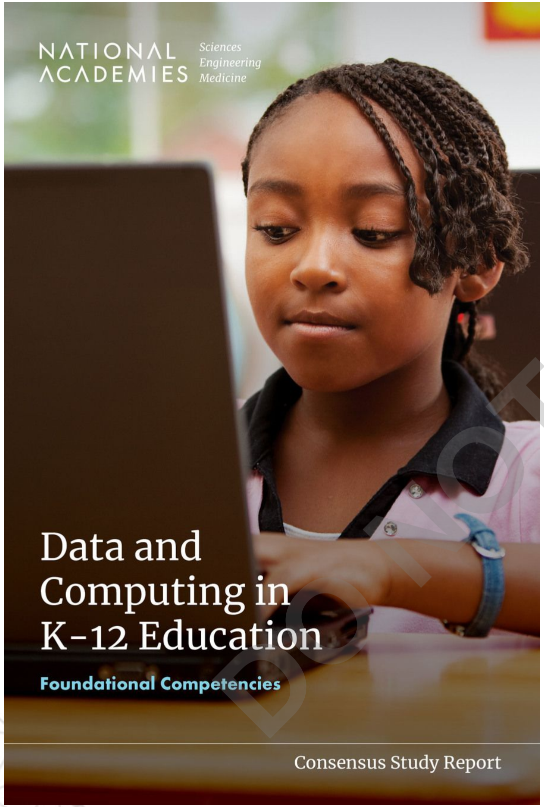
And finally, here it is! The top 25 ranked concepts:

1. **Tool Application (C4.1)** - Use digital tools to summarize data and create visualizations. Apply these tools to identify patterns, clean and prepare data, perform analysis, and build models for simulations to explore relationships and trends.
2. **Correlation versus Causation** (D1.6) - Comfortably separate correlation from causation in a wide variety of situations, building a "first-reaction" thinking habit over time.
3. **Biases in Data** (A2.2) - Recognize all data contains bias but data collection and analysis methods can increase or mitigate the effects of biases.
4. **Representational Fluency** (E1.5) - Identify how layout (ordering, scale, and axes) choices increase clarity or potentially mislead an audience.
5. **Probabilistic Language** (D1.1) - When communicating with others, employ both plain-language and clear vocabulary to regularly describe degrees of uncertainty, both formally and informally as a thinking habit.
6. **Application Fitness** (D3.1) - Regularly identify generalization issues, with frequent comparisons between significant real-world examples and a current analysis.
7. **Iteration, Validation, and Multiple Explanations** (D2.2) - Regularly practice identifying alternative explanations for a result from data, both for interim steps and post-analysis conclusions.
8. **Multivariable Decision-Making** (D1.8) - Clearly describe how to leverage additional variables or additional outside data to make a logical argument, and identify potential risks of overdoing it.
9. **Tool Accessibility for Diverse Learners** (C4.6) - Understand how digital tools can support a broad range of diverse learners. Evaluate their effectiveness and impact, and explore inclusive data representations.
10. **Data Use Risks and Benefits** (A2.1) - Recognize that data can pose risks but also benefits for individuals and groups, and understand its potential uses, limitations, and risks, including unintended consequences.
11. **Priors and Updates** (D1.2) - When encountering new data, integrate probabilistic thinking into everyday situations by explicating prior assumptions and the impact of new data / evidence on those assumptions.
12. **Explaining Significance** (D1.4) - Clearly describe the basic logic of statistical significance to others, differentiating between significance, the size of an effect, and the statistical power of an analysis. Recognize

Subject-Specific Work

What's Next?

Ongoing Research in the Field



DataScience4everyone

2-Year Construction Process

2024 | January — **Outcomes Focus Groups**
12 focus groups across the education sector meet to identify draft learning outcomes by high school graduation.

2024 | August — **Outcomes Public RFI**
Interactive ranking released for classroom educators, parents, academic faculty, and the general public to broaden target learning outcomes by high school graduation.

2024 | October — **Progressions Writing Group**
Education sciences researchers from across disciplines convene to write grade-by-grade learning progressions to reach target learning outcomes.

2025 | February — **Progressions Draft**
Non-subject specific Beta progression for K-12 Data Science & Data Literacy is released, for use by education researchers, curriculum developers, and professional organizations.

CS — Math — Science — Social Studies

Aligned Learning Progressions
Progressions for K-12 Data Science & Data Literacy are developed and integrated into existing frameworks for each relevant school subject, for use by state education agencies and school districts when revising education standards and course offerings.

2027 | February — **Annual Amendments**
Subject-agnostic Core Data Science & Literacy progression is updated annually, incorporating amendments as technology changes and new research emerges, to provide ongoing guidance for subject areas.

- **Expert + public input** > the **socialization process matters** just as much as the content.
- **Subject-specific LPs** > we are developing frameworks with **very targeted intervention points**
- **Adapts over time** > we accept that technology will change, **as well as research,** and view these as opportunities.

K-12 Data Science Learning Progressions

Framework Updates

First-of-its-Kind National Framework
Comprehensive K-12 roadmap developed through a community-driven, grassroots process with 100+ participants across diverse backgrounds and subject areas.

Five Cross-Cutting Strands
Dispositions and Responsibility, Creation and Curation, Analysis and Modeling, Interpreting Problems and Results, Visualization and Communication.

Flexible and Subject-Agnostic
Designed to support integration across all disciplines. Not bound to a single course or pathway, adaptable for any grade band and learning context.

Living Document
Recurring amendment process underway to incorporate emerging practice and community feedback.

Subject-Area Partnereships

Mathematics — In Development
SAP

Science — In Progress
NSTA
Kick off event: April 15th, 2026 | Est. completion: April 2027

Social Studies — Planning
NCSS
Work group begins: Summer 2026 | Est. completion: April 2027

Computer Science — Integrated
CSTA
Data Science concepts included within new CSTA standards | Est. Publication Summer 2026

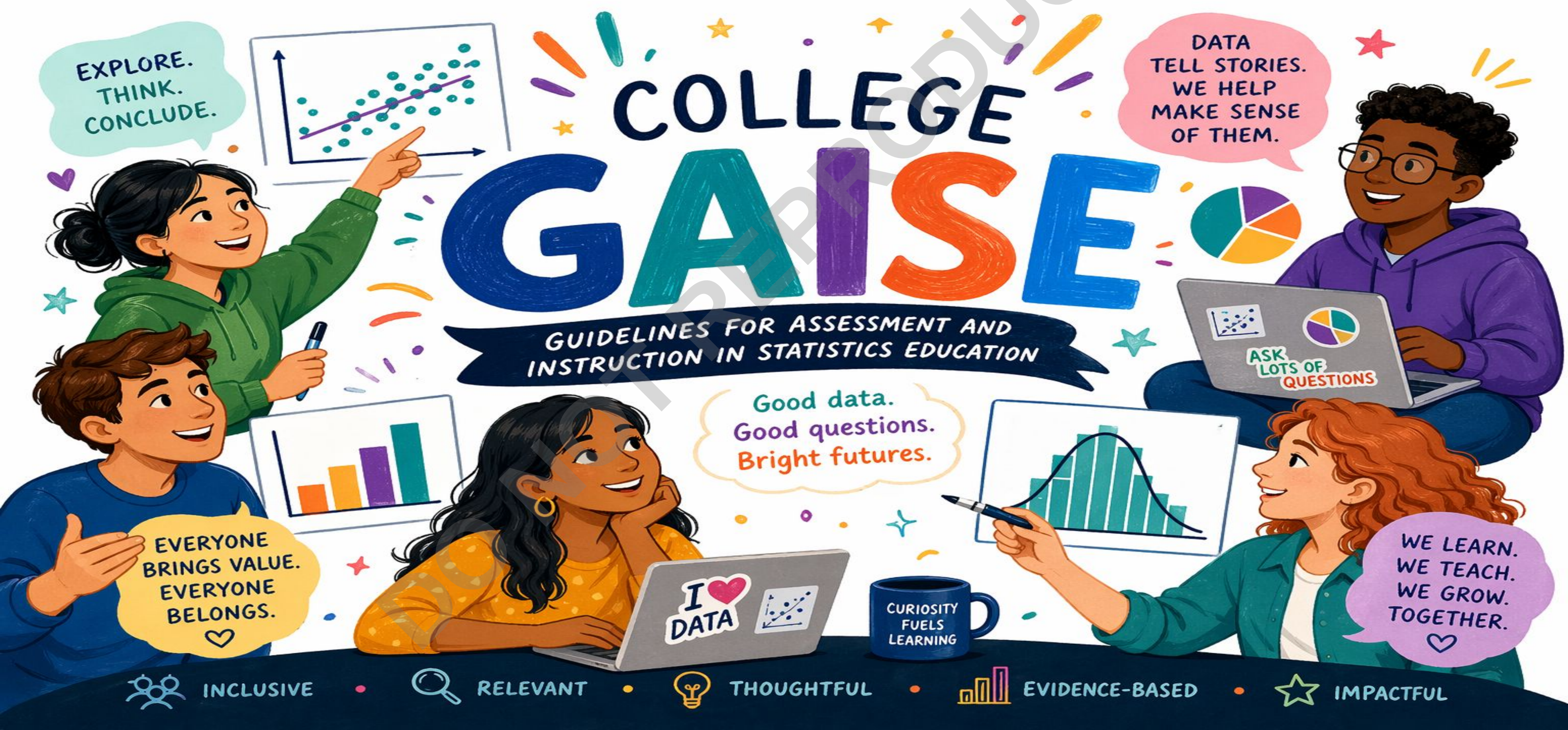
Thank You!

03

College GAISE Report Revision

College GAISE: What is it?

By Patti Frazer Lock and Jamie Perrett

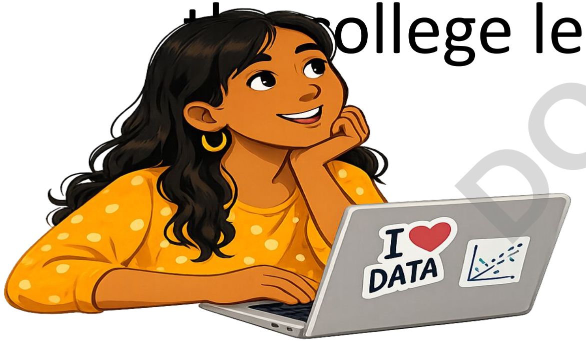


Outline

- What is College GAISE – Jamie Perrett
- Background, History, and Revision – Patti Frazer Lock
  - Why?
  - What?
  - How?

What is College GAISE?

- GAISE stands for “Guidelines for Assessment and Instruction in Statistics Education”
- Set of recommendations created by the American Statistical Association (ASA) to improve how introductory statistics and data science is taught at the college level.



What is College GAISE?

- It is a constantly changing website of resources that allows for it to always be up to date.
- What it includes:
  - 10 Recommendations
  - Student Learning Outcomes
  - Assessment

Ten Recommendations

1. Teach statistics and data science as processes of gleaning insights from data to inform evidence-based decisions.
2. Emphasize effective written and oral communication of results from data, with attention to the scope and limitations of conclusions.
3. Focus on conceptual understanding rather than algebraic manipulation and formulas.
4. Integrate real data with a context and purpose throughout the course. Select data that are meaningful and engaging to the students.
5. Encourage multivariable thinking.
6. Incorporate software/apps to explore concepts and work with data.
7. Emphasize responsible and ethical conduct in the collection and use of data and in their analysis.
8. Employ evidence-based pedagogies that actively engage students in the learning process.
9. Use a variety of formative and summative assessments to improve teaching and learning.
10. Implement inclusive strategies that create learning environments where all students are valued.

Student Learning Outcomes

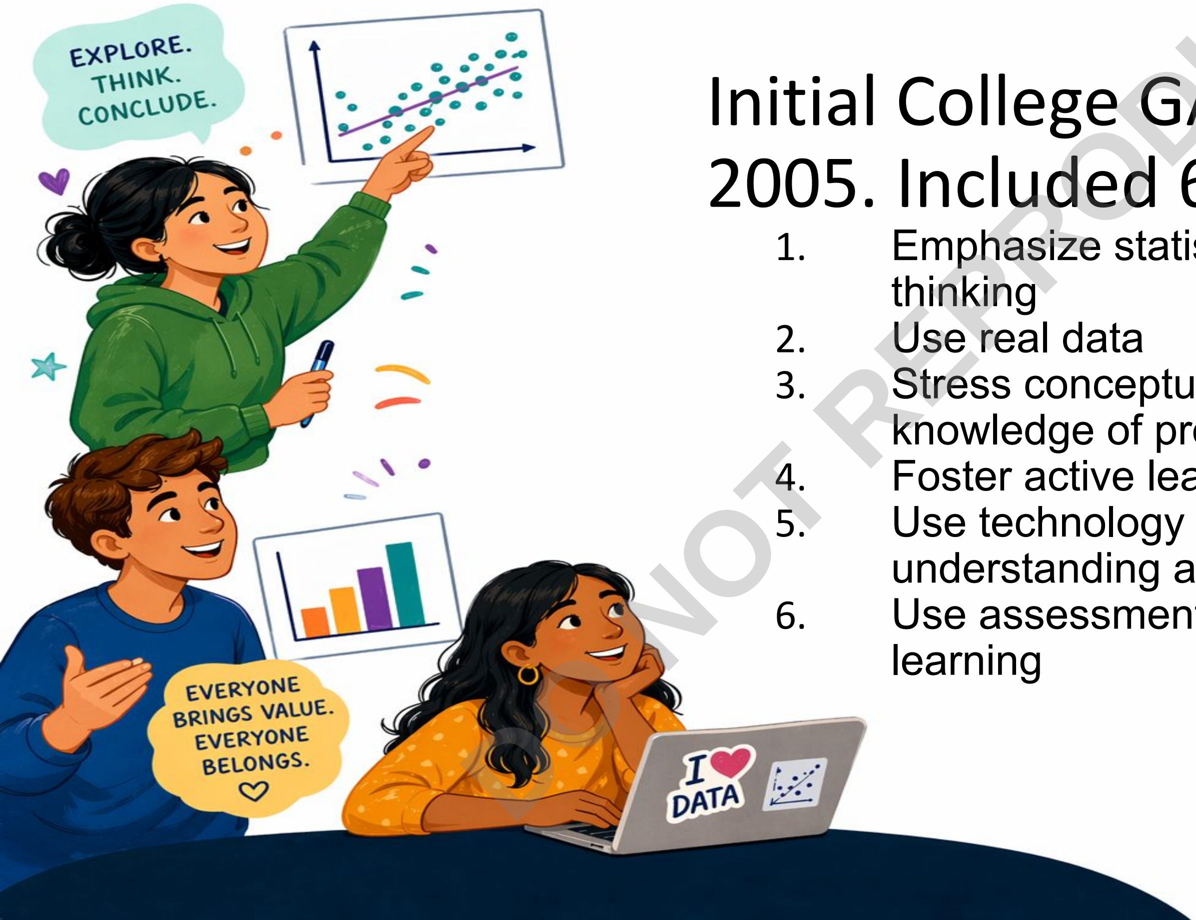
After completing an Introductory Statistics course, students should be able to:

- Identify cases, variables, and types of variables in data sets, including multivariable data sets.
- Explain how study design affects what conclusions can be drawn from the data. In particular, explain the importance of random sampling and random assignment.
- Identify and interpret appropriate graphs and summary statistics in both univariate and multivariate settings.
- Use statistical software or apps to create visualizations, produce summary statistics, and carry out the computational aspects of statistical analysis.
- Articulate the role that random variation plays in statistical inference. In particular, articulate its role in generalizing from a sample to a population.
- Identify the key methods to use in statistical inference and interpret results from those methods.
- Recognize that sampling variation is one reason that conclusions drawn from statistical inference might be incorrect, and that replication and reproducibility are important to verify conclusions.
- Use statistical models, such as linear regression, for prediction.
- Recognize ethical issues and dilemmas in statistical practice.
- Communicate, clearly and in context, results obtained from data.

Assessment

- Statistics and data science problems that teachers can implement directly into their classes
- Great assessment problems for new and experienced teachers
- Mapped to student learning outcomes

The Revision



Initial College GAISE Report issued in 2005. Included 6 Recommendations:

1. Emphasize statistical literacy and develop statistical thinking
2. Use real data
3. Stress conceptual understanding, rather than mere knowledge of procedures
4. Foster active learning in the classroom
5. Use technology for developing conceptual understanding and analyzing data
6. Use assessments to improve and evaluate student learning

2016 College GAISE Report

- Minor edits to the 6 Recommendations
- More resources added
- 142 page pdf

2026 College GAISE Report

- Include Data Science!
- Web document
- Include ethics, inclusion, …

2026 College GAISE Recommendations

Recommendations for Statistics and Data Science

1. Teach statistics and data science as processes of gleaning insights from data to inform evidence-based decisions.
2. Emphasize effective written and oral communication of results from data, with attention to the scope and limitations of conclusions.
3. Focus on conceptual understanding rather than algebraic manipulation and formulas.
4. Integrate real data with a context and purpose throughout the course. Select data that are meaningful and engaging to the students.
5. Encourage multivariable thinking.
6. Incorporate software/apps to explore concepts and work with data.
7. Emphasize responsible and ethical conduct in the collection and use of data and in their analysis.
8. Employ evidence-based pedagogies that actively engage students in the learning process.
9. Use a variety of formative and summative assessments to improve teaching and learning.
10. Implement a course design that uses inclusive strategies to foster a sense of belonging.

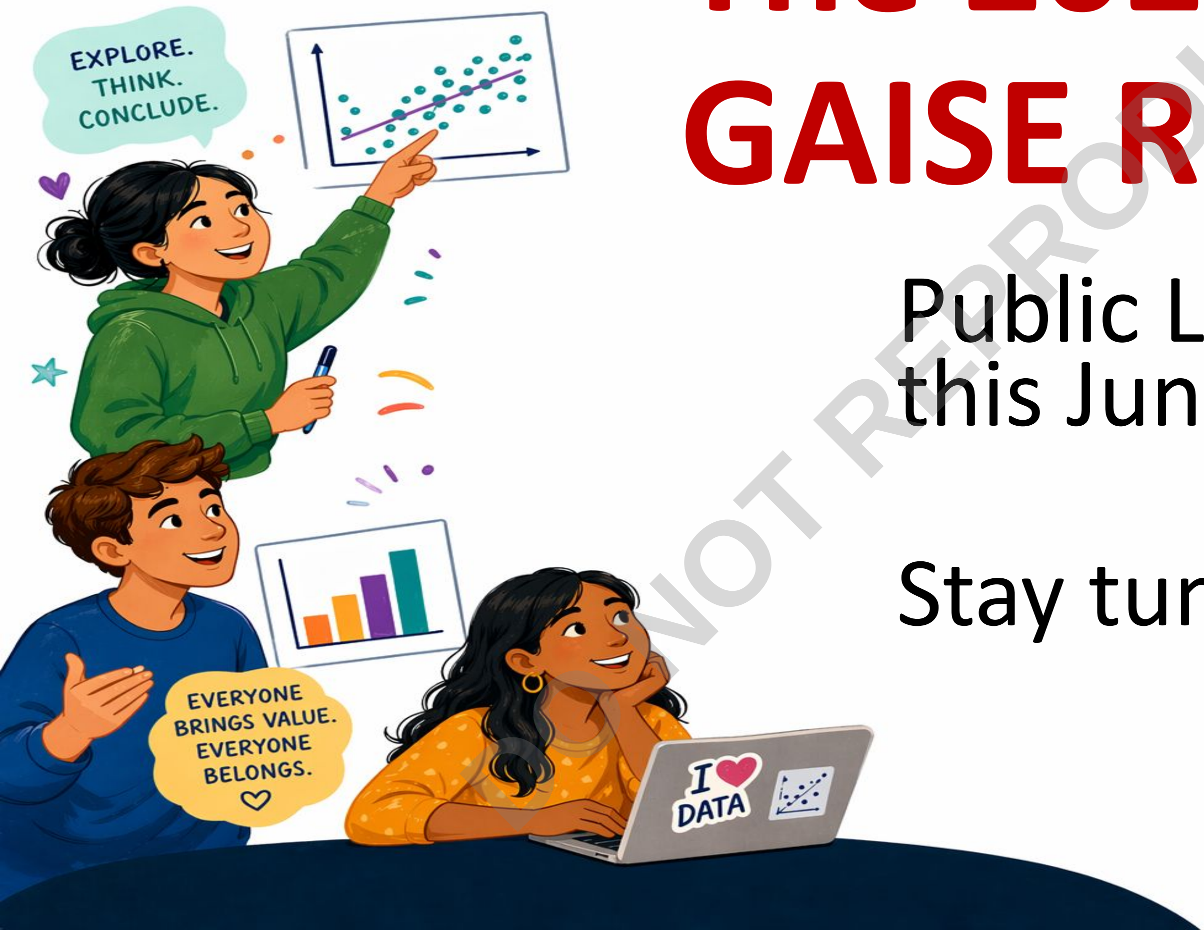
Current State of Data Science

- Where is it being taught?
- Who is teaching it?
- What content is included?
- What are prerequisites, if any? (with thanks to the MASDER Group)

Mapping Competencies to Intro DS

The ***Competencies for Data Science*** document is a continuation of the previously published ***Computing Competencies for Undergraduate Data Science Curricula***. [ACM]

ACM Data Science Task Force. (2021). *Computing competencies for undergraduate data science curricula*. Association for Computing Machinery, New York, NY, USA



The 2026 College GAISE Report!!

Public Launch expected this June/July.

Stay tuned!

Panel Discussion

Q & A

entry points:

Pathways and Possibilities to Support Student Learning about Data and AI

EVENT #1 | POSTSECONDARY PROGRAMS & PATHWAYS

EVENT #2 | K-12 PROJECTS & OPPORTUNITIES

EVENT #3 | NATIONAL FRAMEWORKS & RECOMMENDATIONS

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