Resource Sharing
K-12 Data Science Workshop

Thank you all for your participation and willingness to share resources. Please feel free to enter in your resources below. We will make sure that all links are active.

How to add resources: We are hoping to organize the links by headers. The hyperlinks below will enable you to place links in relevant sections. Add your resources below, making sure it is part of the "bulleted" list. Feel free to add a note about what topic it relates to as well.

Weblinks/Projects

- STEMcoding youtube channel http://youtube.com/STEMcoding
- Earth Exploration Toolbook (many chapters are still relevant!) https://serc.carleton.edu/eet/index.html
- MY NASA DATA project: https://mynasadata.larc.nasa.gov
- GAISEIIPreK-12_Full.pdf (amstat.org)
- SDSTeacherBook-highres.pdf (amstat.org)
- Resources for Data Science Education | DS4E Coalition
- Interesting site to prompt thinking/sensemaking of data: https://slowrevealgraphs.com/ +!
- Makeover Monday
- Zooniverse-Citizen Science
- YouCubed
- Tuva's Data Literacy Instructional Program
- locus.statisticseducation.org - examples of good statistics assessment item
- Anaconda Nucleus, a community platform with educational tools and supportStrengthening Data Literacy across the Curriculum
- WeatherX
- NASA Data Integration with Code.org, a collaboration between the Virginia Space Grant Consortium, West Virginia Space Grant Consortium, CodeWV, CodeVA, Code.org, and My NASA Data; announcements forthcoming, point of contact: Julie Back with VSGC, jback@odu.edu
- Data Science PBL module: https://powerofdatascience.org/
- Statistics/Data Science PBL course: https://passiondrivenstatistics.com/
- Data4Kids data stories - Urban Institute

- Advancing Equity with Community Data Partnerships- We Need to Hear from You. OSTP project https://www.whitehouse.gov/ostp/news-updates/2022/09/06/advancing-equity-with-community-data-partnerships-we-need-to-hear-from-you/
- Cosmic Data Stories: Cosmic Storytelling with NASA Data (NASA Science Activation Project)—resources are still under development, but first story coming this fall https://www.cosmicds.cfa.harvard.edu/
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Technological Tools

- STEMcoding object tracker https://arxiv.org/abs/2206.07909 http://go.osu.edu/objecttracker
- Engaging Space: Designing an accessible digital universe. An overview of available data tools from NASA for STEM Education (Google Slides).
- FIeldScope Map-based data collection and analysis platform from community and citizen science
- Here is a great resource https://www.census.gov/quickfacts. A webinar explaining how to use it "*American Community Survey: A Comprehensive Look*" [held August 24, 2022] available online Sept. 24, 2022 at https://www.census.gov/data/academy.html.
- CODAP Common online data analysis platform
    - The Story Builder plugin for CODAP allows students to record and replay steps of their analysis. It also allows for integration of text, images, videos, news stories, and other multimedia resources to be put into conversation with datasets.
- Tinkerplots can be used elementary school and up
- Fathom can be used MS/HS and up
- Tuva - Data, graphing, modeling, and statistical tools pedagogically sound lessons and data stories, for grades 3 and up.
- DataClassroom - Complete online platform for teaching and learning with data in grades 6-12. Built to grow with students from their first digital graphs through understanding the math of inferential statistics. DataClassroom U includes a Bridge to R for generating example code in R.
- Integrated Statistics Learning Environment
- The world's most popular open-source Python distribution platform and Anaconda Nucleus, a community platform with educational tools and support
- glue open source software for multi-dimensional linked-data exploration (this link is for the QT desktop version); has much in common with CODAP.
    - glupyter variant of glue designed for use in jupyter notebooks and online resources like Cosmic Data Stories.

Data Sets

- Tuva's Content Library
- DataClassroom's Resource Library
- The GLOBE Program data: GLOBE Data
- COVID-19 Data Repository by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University
- EDC's Oceans of Data Institute (ODI): Resources for Educators Using Data in the Classroom
- Data and Story Library
- US Census Data
- Google Dataset Search
- Kaggle Datasets
- Data.gov - open US Government data sets
- Earthdata - open access data from NASA
- Global Health Observatory - from WHO
- CORGIS - Collection of Really Great Interesting Situated Datasets
- Data Nuggets
- Gapminder
- Data Is Plural (data-is-plural.com) - weekly newsletter of useful/curious datasets
- Data.gov Home of US government's open data
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Citizen Science (aka Community Science, Participatory Science)

- EPA's Quality Assurance Handbook and Toolkit for Participatory Science Projects https://www.epa.gov/participatory-science/quality-assurance-handbook-and-toolkit-participatory-science-projects
- Community Collaborative Rain, Hail & Snow Network (CoCoRaHS) [mentioned by a speaker] https://www.cocorahs.org
- A Day in the Life of the Hudson River ("Snapshot Day"): https://www.ldeo.columbia.edu/edu/k12/snapshotday/
- NASA GLOBE (www.globe.gov)
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Articles

- Invited manuscript
  Practical Approaches to Advance K-12 Data Literacy | CADRE
- Kastens, Kim. (2015, May). Data Use in the Next Generation Science Standards (revised edition) [White paper]. Waltham, MA: Oceans of Data Institute, Education Development Center, Inc. Retrieved from http://oceansofdata.edc.org/our-work/data-next-generation-science-standards This white paper has two potentially useful aspects: (a) an analysis of where data use can be found throughout the NGSS, including non-obvious places, and (b) comparison of data use in the NGSS versus the data-using skills that were called for a DACUM workshop of data using professionals.
- A set of blog posts from the Earth & Mind website, all dealing with how to extract meaning from data (mostly spatial data, mostly Earth data)
  - * Data Visualization as a Rorschach Test: https://serc.carleton.edu/earthandmind/posts/deathrates.html
  - * What precursor understanding underlie the ability to make meaning from data: https://serc.carleton.edu/earthandmind/posts/spilledmilk.html
  - * "Some students will..." https://serc.carleton.edu/earthandmind/posts/somestudents.html Relevant to the workshop question of what does everyone have to learn, and what is for only some people.
  - * Turning nature in to categories https://serc.carleton.edu/earthandmind/posts/natureintocateg.html
  - * "Learning to learn from data" https://serc.carleton.edu/earthandmind/posts/datalearningpro.html
  - * Seismologists gather for "Discourse over Materials": https://serc.carleton.edu/earthandmind/posts/seismologistsdi.html
  - * Milk comes from the store; Data comes from the internet: https://serc.carleton.edu/earthandmind/posts/datafrominterne.html
  - * Where do data-driven visualizations come from: https://serc.carleton.edu/earthandmind/posts/datadrivenbacks.html
  - * Data-driven versus concept-driven visualizations: https://serc.carleton.edu/earthandmind/posts/datadrivenvis.html
  - * Turning nature into numbers: https://serc.carleton.edu/earthandmind/posts/realitytonumber.html
  - * More hypothesis templates: https://serc.carleton.edu/earthandmind/posts/more_hypothesis.html
  - * The meaning of "meaning": Causes and consequences: https://serc.carleton.edu/earthandmind/posts/meaning_meaning.html
  - * "Hypothesis templates" for extracting meaning from spatial information: https://serc.carleton.edu/earthandmind/posts/hypothesis_temp.html

- Kastens, K. A., Krumhansl, R., & Baker, I. (2015). Thinking Big: Transitioning your students from working with small student-collected data sets towards "big data". *The Science Teacher, 82*(5), 25-31. Available at http://oceansofdata.org/our-work/thinking-big
- Kelly, S. (2021). Digging for data: Mining geoscience databases to deepen and expand STEM learning opportunities. The Science Teacher, 88(5). (https://www.nsta.org/science-teacher/science-teacher-mayjune-2021/digging-data)
- Hammett, A. & Dorsey, C. (2020). Messy Data, Real Science. *The Science Teacher*,87(8), 40-48. [Article download]
- Preparing Virginia's Students for New Post-secondary Pathways in Data Science Mazzacane T., Crawford D., Bussian L., Vasudevan A., and Seshaiyer. P (2022), SIAM News,https://sinews.siam.org/Details-Page/preparing-virginias-students-for-new-post-secondary-pathways-in-data-science
  Duschl, R. & Bybee, R. (2014) Planning and carrying out investigations: an entry to learning and to teacher professional development around NGSS science and engineering practices. *International Journal of STEM Education* 1:12. Special Issue. https://DOI 10.1186/s40594-014-0012-6
- Kastens, K. A., Shipley, T. F., Boone, A., & Straccia, F. (2016). What geoscience experts and novices look at, and what they see, when viewing data visualizations. *Journal of Astronomy & Earth Science Education, 3*(1), 27-58. Retrieved from http://www.cluteinstitute.com/ojs/index.php/JAESE/article/view/9689
- Kastens, K. A., Zrada, M., & Turrin, M. (2019). What kinds of questions do students ask while exploring data visualizations? *Journal of Geoscience Education*. doi:10.1080/10899995.2019.1675447
- Hays, J. D., Pfirman, S., Blumenthal, M., Kastens, K., & Menke, W. (2000). Earth Science Instruction with Digital Data. *Computers and the Geosciences, 26*, 657-668. [a pioneering effort to introduce learning via data exploration with large, professionally collected data sets into Earth Science classrooms (intro undergrad) beginning more than 25 years ago]
- https://www.youcubed.org/resource/data-literacy/
- Lee, V. R., Wilkerson, M. H., & Lanouette, K. (2021). A call for a humanistic stance toward K-12 data science education. *Educational Researcher, 50*(9), 664-672. doi: 10.3102/0013189X211048810
  https://journals.sagepub.com/doi/full/10.3102/0013189X211048810
- Conference Session: Centering Equity in Data Science Education | The Mathematics of Opportunity: Charting a Path to Equity | Just Equations
- Duschl, R. & Ellenbogen, K. (2009). Argumentation and Epistemic Criteria: Investigating Learners' Reasons for Reasons. Educacion Quimica, April, 111-118. (This study engaged MS students in an 'Exercise for a Healthy Heart' curriculum with recording of class level heart data - before and after exercise and than asking what is the range of a normal heart rate)
- Calculating the Odds: Counselor Views on Math Coursetaking and College Admissions

Books

- Kastens, K. A., & Turrin, M. (2010). *Earth Science Puzzles: Making Meaning from Data*. Washington, D.C.: National Science Teachers Association. https://my.nsta.org/resource/2627 Although 12 years old, this book may be of interest to current data science education developers because of its focus on PCK (pedagogical content knowledge) that will help teachers be better at helping students extract meaning from data.
- Free, downloadable book from ASA: Statistics and Data Science for Teachers
- Calling Bullshit by Bergstrom and West.
- Cathy O'Neil, Weapons of Math Destruction
- Ruha Benjamin, Race After Technology
- W.E.B. Du Bois, Data Portraits: Visualizing Black America
- Meredith Broussard, Artificial Unintelligence: How computers misunderstand the world
- Michael M. Dediu, Our Future Depends on Good World Education

Frameworks

- Pre-K–12 Guidelines for Assessment and Instruction in Statistics Education II (GAISE II)
- Dana Center DS Framework: Data Science Course Framework
- The big ideas of data science K-12 - developed by Rob Gould, Jo Boaler, et al: https://www.youcubed.org/data-big-ideas/
- VA HS Data Science Course Curriculum Framework https://doe.virginia.gov/boe/meetings/2022/04-apr/item-g.pdf
- Epidemiology and Public Health Science: Core Competencies for High School Students (CDC, 2015)
    - From Jacob Sagrans (email to contact me for more info): We referenced this in our ITEST proposal for the COVID-Inspired Data Science Education through Epidemiology project, writing: "In 2015 the CDC articulated four core competencies in epidemiology for grades 9–12 and aligned them with the NGSS (Cordeira & Cordell, 2015). While these competencies emphasize data-driven thinking, epidemiology curricula and out-of-school programs by and large do not put actual datasets in the hands of students."
- Building Blocks for Data Literacy - designed as a reference and discussion-starter for teachers and other educators as we all explore how to engage K-12 students with data. It is a draft — an ongoing work in progress that will evolve with input from readers.
- Standards: https://xkcd.com/927
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Curriculum

- High school data science course; currently in flight at private school in Charlottesville, VA. Please email Adam Tashman apt4c@virginia.edu (Assoc Prof, UVA School of Data Science) if interested in learning more / accessing the course materials.
- The GLOBE Program https://www.globe.gov/
- VA HS Data Science Course Curriculum Framework (not a curriculum): https://doe.virginia.gov/testing/sol/standards_docs/mathematics/2016/cf/data-science-cf-2022.pdf
- EDC's Oceans of Data Institute (ODI) has compiled a list of data activities, lessons, and resources for the classroom, sorted by grade level: Resources for Educators Using Data in the Classroom
- American Geosciences Institute (AGI) and EDC Ocean's of Data designed a lesson sequence for elementary students about rivers and flooding, which incorporates river height, rainfall, and land cover data and physical models: Streams of Data. Full lesson plans, data details, model instructions, slide decks and more are available. Contact lbrase@americangeosciences.org for more info.
- Gulf of Maine Research Institute (GMRI): Data-rich modules for ecosystem investigation (some in the format of community science projects) featuring intersections between data on local climate impacts and global climate data: https://teach.gmri.org/
- Introduction to Data Science - California data science course for high school students
- https://hsdatascience.youcubed.org/ High school course from Stanford / youcubed
- K-12 Data lessons: https://www.youcubed.org/data-science-lessons/
- Data Talks for K-12 https://www.youcubed.org/resource/data-talks/https://www.youcubed.org/resource/data-literacy/
- Data Story Bytes - from the Writing Data Stories project (UC Berkeley, North Carolina State University, and Concord Consortium) Lesson plans and a more general DIY framework for supporting critically-oriented conversations about existing data visualizations. The framework includes prompts to encourage: (1) making sense of trends in data visualizations; (2) finding personal connections to the patterns and phenomena represented; (3) exploring the data's context and history (including issues of bias and data construction); and (4) and envisioning future uses of the data and visualization.
- USS-DATA - Curriculum modules developed with mathematics and social studies teachers for high school to explore topics of income inequality and immigration in the U.S., using person-level microdata from the U.S. Census and the American Community Survey, using CODAP. Developed and field-tested by the Strengthening Data Literacy across the Curriculum project, based at EDC.
- UC Berkeley's Data 6 and Data 8 materials are free and online. Data 6 is an "Introduction to Computational Thinking with Data" and serves as a bridge program into Data Science and other data/computing-intensive study paths. Data 8 is Berkeley's "Fundamentals of Data Science" course and has also been adopted by some high schools. More Info here.

- Data Clubs out-of-school middle school data modules on “Teens and Time,” “Ticks and Lyme Disease,” and “Injuries On and Off the Field.” Joint project of TERC and Science Education Solutions.
- Elementary Science and Data Science
- Narrow in focus, but free lessons for grade 3-5 and 6-8 on climate change using data analysis https://learn.eie.org (must create a login – lessons currently highlighted in banner upon login)
- CourseKata
- One pager on Data Detectives Clubs and link to request the curriculum. This is out-of-school middle school curriculum from the COVID-Inspired Data Science Education through Epidemiology project. 15-20 hour curriculum that introduces middle school youth to data science and epidemiology using CODAP and the lens of COVID and other other epidemics.
- Bootstrap World Data Science
- Passion-Driven Statistics Project-Based Curriculum used in several high schools and as a summer data boot camp for students as early as grade 8.

Teacher Prep Programs/Docs

- Professional learning opportunities around data acumen/literacy/fluency (would love to connect with any and all interested in cross promotion, collaboration, or coordination on PL for in-service teachers around these topics, especially across disciplines and grade levels)
    - https://dataspire.org/data-literacy-series
    - https://dataspire.org/trainings
    - https://dataspire.org/school-partnerships (a bit out of date ;))
- ADVizE - A Data Visualization Experience for Preservice Teachers (ADVizE) supports higher education faculty in guided efforts to implement data literacy skills into STEM education methods courses, thereby providing K-8 preservice teachers the skills and self-efficacy to work with data and integrate data literacy into their future classrooms. Four cohorts of five faculty members each will attend a two-day Faculty Training Institute (FTI) in which they are trained to integrate the five session ADVizE Curriculum Supplement Initiative (CSI) into their courses. This is a partnership between The College of New Jersey, the State University of New York at Fredonia, the University of Wisconsin, and Dataspire.
- Learning Ecosystems Northeast (hosted by GMRI) is supporting peer communities of teachers, informal educators, and librarians to engage youth in data-rich explorations of ecosystem change in the northeast. Opportunities for professional learning through numerous institutes, webinars, etc. listed at https://teach.gmri.org/
- Jefferson Lab JSAT Program - JSAT is an after school program for 5th, 6th and 8th grade science teachers designed to build teachers' skills in the physical sciences, funded by the Jefferson Science Associates Initiatives Fund. The program will include interactive activities to enhance physical science instruction at the middle school level

and lectures by Jefferson Lab staff on the applications of science. And, yes, teachers WILL receive class sets of some activities!
- Utah's Data Science Microcredential Stack for in-service teachers.
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Upcoming Events

- Data Literacy Series (Thursdays Sep 29th - Dec 1st) - professional learning for science, social studies, and math teachers in grades 3-12. Discuss 7 common tripping points for students with data, strategies to address them in whatever curriculum or platforms you are using, and how to integrate it in
- Gordon Research Conference: Visualization in Science and Education (July 16-21 2023) The 2023 meeting will bring together a multi-disciplinary group including researchers from the social and natural sciences, artists, technologists, journalists, educators from formal and informal settings, and others engaged in the production, study, and application of visualizations to advance and promote scientific understanding. The theme for the 2023 conference is "Visualizing Complex Systems", which will involve exploration of multi-dimensional topics such as climate change, epidemics, Indigenous knowledge systems, and social justice. Mini grants are provided to support further development of collaborations that emerge in the meeting, including several collaborations through the years who have gone on to win funding from NSF and other federal agencies.
- Anaconda's Data Science Expo pilot - available in Austin, TX, Louisville, KY, and Raleigh-Durham, NC for High School/ Homeschool Students (Grades 9-12). This competition is a great way to develop high school students' skills in Data Science, have a chance to win up to 5k USD in scholarships and have fun while doing it! Email education@anaconda.com for information.
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Other

- Michigan's "Essential Instructional Practices for Disciplinary Literacy in the Secondary Classroom" - see the mathematics section in particular for practices related to data and data science. See full DL resources here.
- UW's Calling Bullshit course: https://www.callingbullshit.org/
- Nathalie Miebach: "I explore the intersection of art and science by translating scientific data related to meteorology, ecology and oceanography into woven sculptures and musical scores/ performances."
- Ways to connect out and share with one another going forward?
    - https://www.facebook.com/groups/dataspirededucators
- Sports Content for Outreach, Research, and Education (SCORE)

- Conference Session: Math and Its Aftermath: Reimagining Data for Justice | The Mathematics of Opportunity: Advancing Social Justice Through Math Education | Just Equations
- AUC Data Science: https://aucenter.edu/category/data-science/