STEM-Centered Learning

Davis School District

2019-2020
Summary Report

CONTENTS

Wonder
Problem Solving
Sense Making

Science
Technology
Engineering
Math

STEM-Centered Learning

Creativity
Critical Thinking
Collaboration
Communication

Real-World
Application
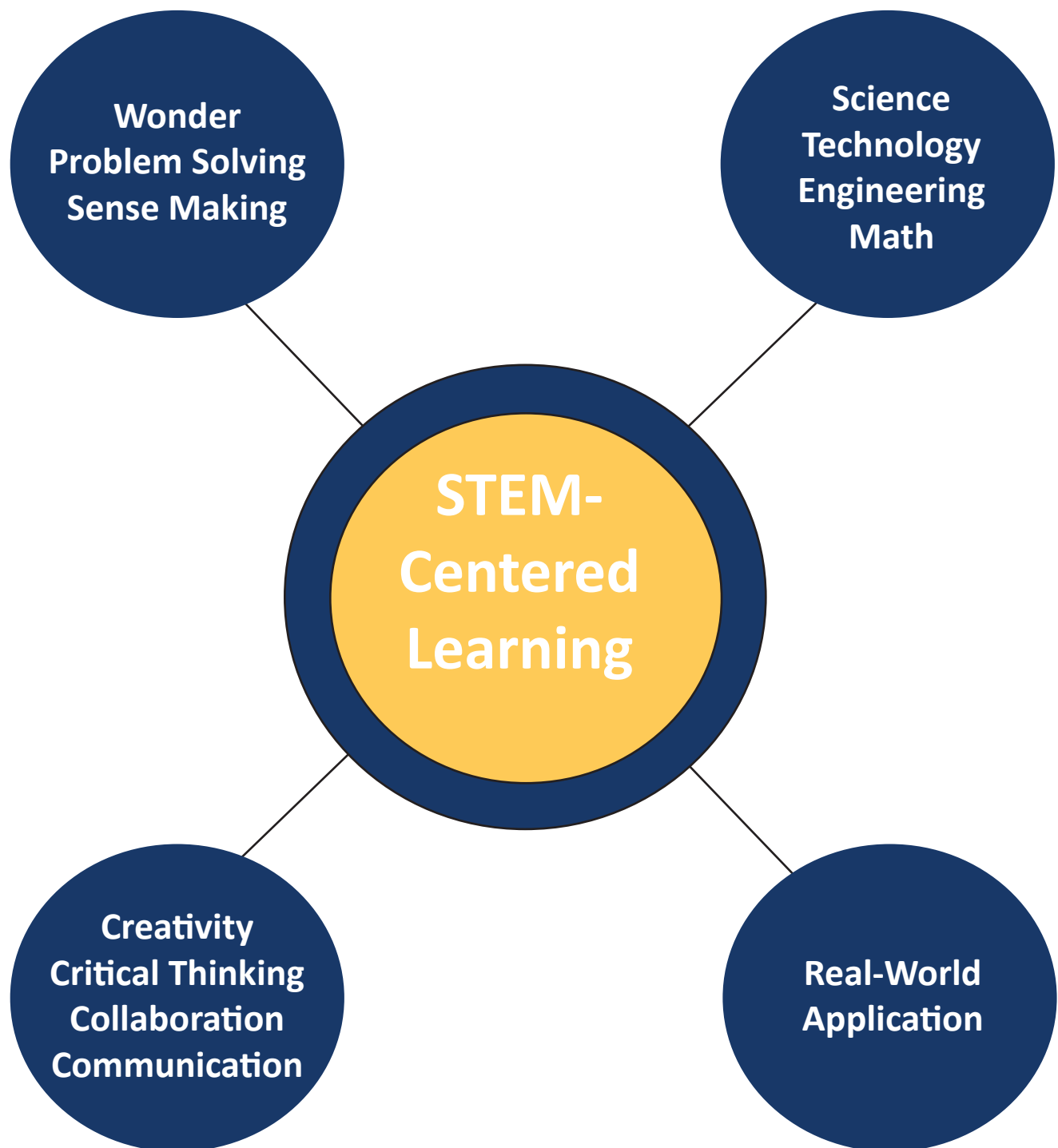
STEM-centered learning focuses student thinking and discussion around real-world phenomena, problems, issues, or events across all content areas with the purpose of students collaborating in order to make sense of the world and persevere in solving problems.
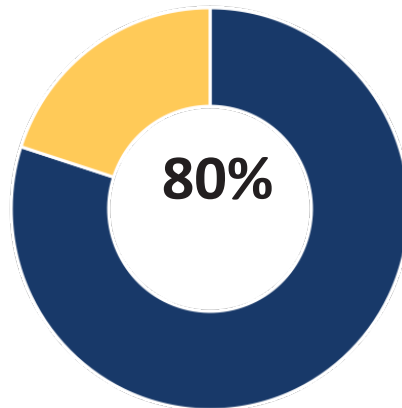
2019-2020 | AT A GLANCE

75,115
Students Receiving a STEM Education

354
Teacher Professional Learning Opportunities

$1,898,120
in STEM Grant Funding

80%
STEM-Centered Learning Present in **80%** of Classrooms

+43%
Increase in Advanced Math Enrollment Since 2015

238
Secondary STEM Courses

District-Sponsored Elementary Curriculum: Math, Science, & Computer Science

STEM-CENTERED LEARNING

Davis School District's mission is Learning First. Everything in DSD is done to fuel student learning. Teachers are constantly learning and growing to meet the ever-diverse needs of our students. STEM in DSD incorporates eight key indicators: wonder, sense making, problem solving, creativity, communication, collaboration, critical thinking, and grit. Together, these eight indicators shape instruction in DSD to support student success and growth.

STEM traditionally stands for Science, Technology, Engineering, and Math. In Davis School District (DSD) STEM has been refined to focus on students experiencing wonder, sense making, and problem solving across all content areas in a collaborative, creative, and real-world environment. Davis School District strives for students to experience something beautiful, unexpected, unfamiliar, or inexplicable every day.

Teachers guide students to wonder about the world around them by engaging them in real-world problems, tasks, natural phenomena, issues, or events allowing student questions to drive the learning. Students engage in exploratory inquiries, gain an understanding of gathered information, and assign meaning to perceived randomness. Additionally, students will focus on patterns for prediction to understand phenomena. In DSD problem solving is a collaborative process of discovering solutions to difficult or complex issues.

When students work together on a problem, they must think critically and creatively while also building self-awareness, self-management, and personal responsibility to the group. The problem-solving process requires students to utilize prior knowledge, analyze facts, and gather data. By engaging students in creative problem solving, we will equip students with vital skills for future success.
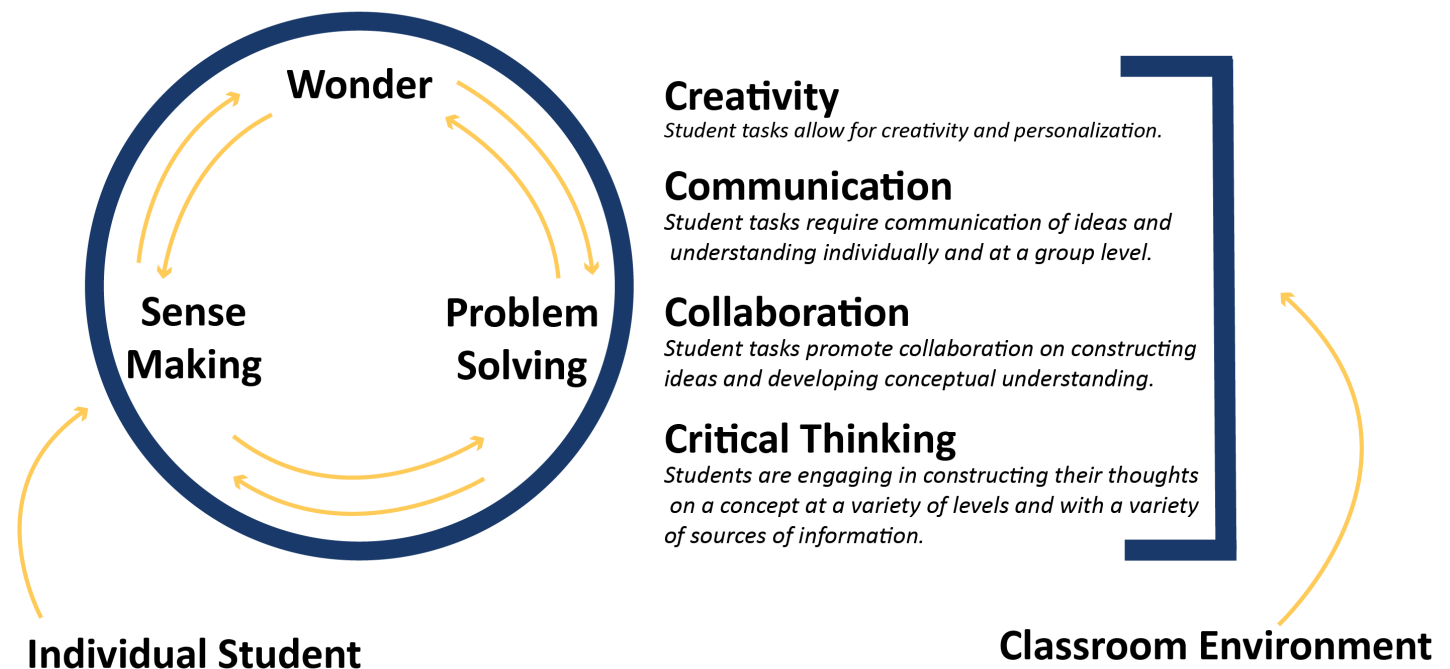
75,115
students in Davis School District are receiving a STEM education

Wonder

Sense Making

Problem Solving

Creativity
Student tasks allow for creativity and personalization.

Communication
Student tasks require communication of ideas and understanding individually and at a group level.

Collaboration
Student tasks promote collaboration on constructing ideas and developing conceptual understanding.

Critical Thinking
Students are engaging in constructing their thoughts on a concept at a variety of levels and with a variety of sources of information.

Individual Student

Classroom Environment

*Figure 1. Student-centered model that drives STEM learning opportunites in Davis School District.*

DATA-DRIVEN DECISION MAKING

Data-driven decision making, the process of making organizational decisions based on data rather than intuition, drives STEM initiatives in Davis School District.

Davis School District's comprehensive data collection provides accurate measurements and tracking of student, teacher, and district performance. The data focus in 2019-2020 included a district-wide survey by administrators and a classroom observation tool to measure and better understand the state of STEM-Centered Learning. These data sources were used to compile a data base of current STEM programs, curriculum, mentality, performance, and professional learning needs to better serve and support teachers.

SCHOOL-LEVEL PROGRAMMING SURVEY

Administrators at 89 school locations throughout the district participated in a school-level programming survey. Data collected provided insight into school processes, programs, mentality, daily functions, and teacher requests (Table 1). Efforts have focused on the new STEM definition in DSD and the pedagogy to successfully educate students to wonder, sense make, and problem solve. The data support training and communication efforts from the Teaching and Learning Department to increase STEM-Centered Learning opportunities. To further combat the main obstacles of STEM success identified during the school- level programming survey (Innovation Overload), the DSD STEM team will offer targeted professional learning opportunities and resources to ease the learning curve, such as creating Canvas courses, writing new curriculum, and providing on-site and virtual training to help teachers succeed.

70%
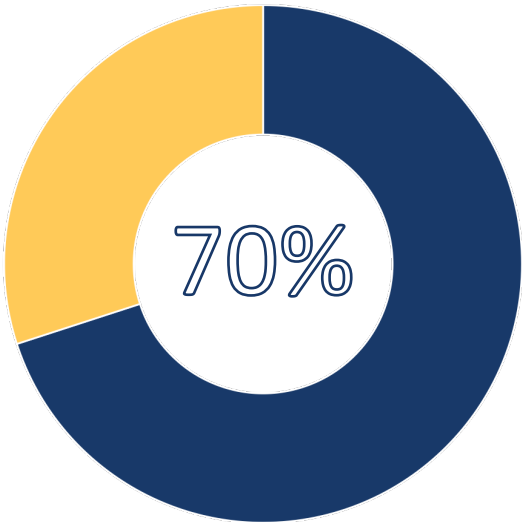
70% of schools applied for grants to funds STEM-related programs and initiatives

| Table 1. School Level Programming Survey Response Data	
Survey Question	**Most Frequent Adminstrator Reponse**
Resources to help teachers implement interdisciplinary activities	Collaboration and Professional Learning Opportunities (62%)
Definition of STEM-Centered Learning	Problem solving, critical thinking, collaboration, communication, and creativity integration into all content areas (60%)
The state of STEM-Centered Learning	STEM-Centered Learning is 'Somewhat Evident' to 'Evident' (75%)
The main obstacles of STEM success	Innovation Overload (37%)
Designated STEM budgets	STEM Budget (39%) No STEM Budget (61%)

EVALUATE DAVIS

Evaluate Davis is a teacher observation tool to assess performance of standards and indicators. Teaching observations allow supervisors to provide educators ongoing performance feedback throughout the year to improve practices. Teachers are evaluated on a scale from one to four to indicate the evidence level for each question: (1) Not Evident, (2) Somewhat Evident, (3) Evident, and (4) Extraordinary. Two specific questions from the teacher observation tool directly relate to STEM-Centered Learning (Table 2). These questions evaluate the evidence level of students asking questions, solving problems, thinking critically, communicating, and applying solutions to real-world situations.

The average score for question 18 was 2.7, indicating that STEM-Centered Learning through problem solving and critical thinking is at least somewhat evident to evident in the majority of classrooms. For this question, 81% (9% Somewhat Evident, 64% Evident, 8% Extraordinary) of evaluations reported some evidence of student engagement in high- level thinking through questioning, solving real-world problems, and critically analyzing information (Figure 2). Contrastingly, 19% of observed teachers did not demonstrate evidence of STEM-Centered Learning. The teachers that did not show evidence of STEM-Centered Learning provide insight for future professional learning opportunities that focus on problem solving and critical thinking activities.

The average score for question 27 was 2.9, again demonstrating evidence of STEM-Centered Learning through students questioning and sharing opinions in the majority of classrooms. Data reveal 96% (3% Somewhat Evident, 87% Evident, 6% Extraordinary) of classroom teachers demonstrated evidence of encouraging students to take risks, ask questions, and share opinions (Figure 3). Only 4% of teachers did not demonstrate evidence of this indicator, supporting district efforts to shift teacher mindset to integrate STEM-Centered Learning into teaching practices.

Table 2. STEM-related questions included in the Evaluate Davis teacher observation tool

Question 18:
Learners have opportunities to engage in higher level thinking through questioning, solving real-world problems, critically analyzing information, etc.

Question 27:
Students are willing to take risks in learning (ask and respond to questions, hypothesize, share alternative options and/or opposing opinions, etc.)
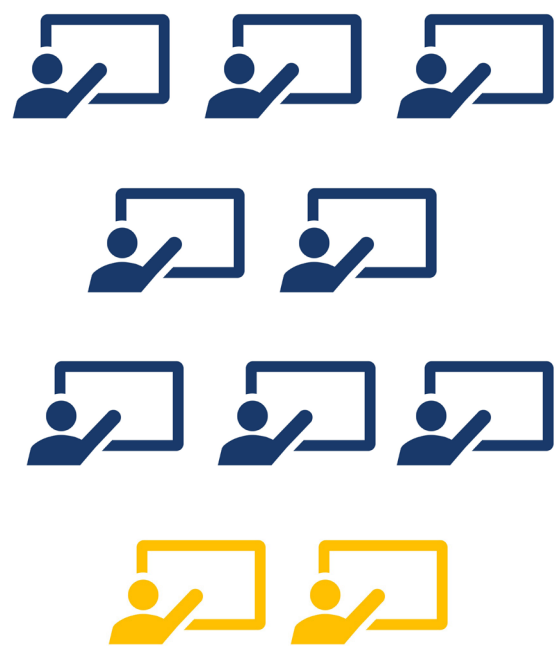
80% of teachers demonstrated evidence of STEM-Centered Learning
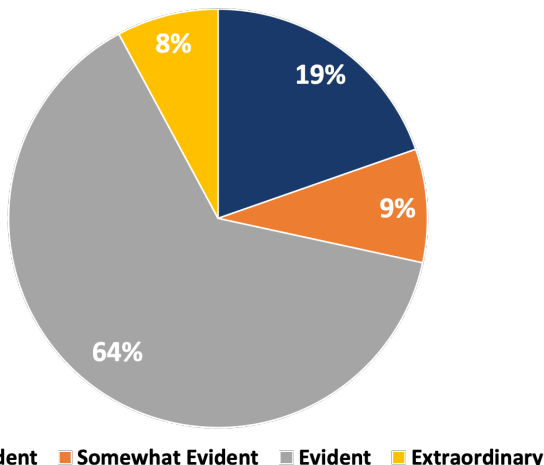
Evidence of STEM-Centered Learning
Question 18

■ Not Evident ■ Somewhat Evident ■ Evident ■ Extraordinary

Figure 2. Classroom observation survey results for question 18 on Evaluate Davis.

Evidence of STEM-Centered Learning
Question 27

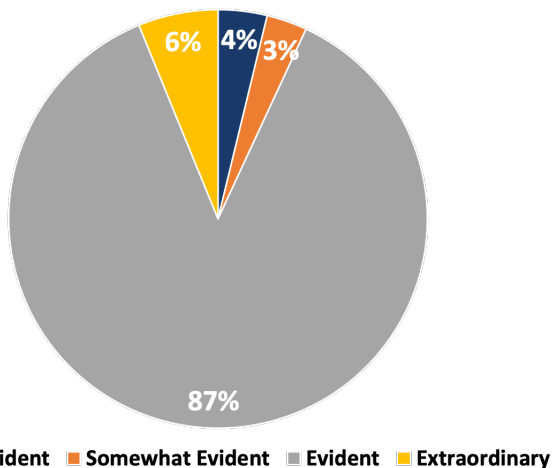■ Not Evident ■ Somewhat Evident ■ Evident ■ Extraordinary

Figure 3. Classroom observation survey results for question 27 on Evaluate Davis.

Evaluate Davis Responses:

"Students were willing to share with partners and then with the whole group. Multiple students took a risk in sharing their various strategies and mathematical thinking processes."

"All students are willing to attempt solutions and talk about their thinking."

"Students were offering ideas and responses even when they were not sure they were correct. Students were asking questions and saying what they did and did not understand."

CONTENT AREA HIGHLIGHTS

"In a world that's becoming increasingly complex, where success is driven not only by what you know, but by what you can do with what you know, it's more important than ever for our youth to be equipped with the knowledge and skills to solve tough problems, gather and evaluate evidence, and make sense of information."
-U.S. Department of Education

Each content area of the STEM department provided resources and professional learning opportunities necessary to move education forward and prepare students to be future problem solvers and collaborators. The STEM department content areas include science, math, computer science, and supplemental STEM. Cumulatively, the STEM department has offered 354 professional learning opportunities for teachers and provided additional on-site and virtual support as requested.

ELEMENTARY & SECONDARY SCIENCE

Elementary science implemented new K-6 standards to provide students a framework to obtain, evaluate, and communicate information about scientific topics. Efforts to integrate the new standards district- wide have focused on teacher professional learning opportunities and a new comprehensive curriculum.

PROFESSIONAL LEARNING

Elementary science professional learning emphasized the new SEEd standards. During the 2019-2020 school year, 88 training opportunities were provided for over 1,200 teachers to transition to the new standards. Secondary science emphasized STEM-centered learning, and professional learning opportunities shifted to a personalized site-based approach. This year, 48 secondary science professional learning opportunities were offered, and 432 teachers participated. Each training was held at the school level, and all members of a faculty participated. The trainings focused on the STEM definition and supports necessary for implementation.

UTAH SCIENCE WITH ENGINEERING EDUCATION (SEEd) STANDARDS

The new SEEd standards provide improved learning opportunities for 39,470 elementary students in DSD. The Utah Science with Engineering Education standards concentrate on what science is, how science is learned, and the multiple dimensions of scientific work. The new SEEd standards also implement 3D learning, science and engineering practices, crosscutting concepts, and disciplinary core ideas.

SEEd Storylines:
1,000,000+
site hits since development

SEEd STORYLINES

Storylines were developed to give relevance to science activities by providing narratives that drive the understanding of big ideas. Storylines focus on inquiry-based narratives with a set outcome, and students are driven by answering questions and engaging with each phenomenon (Figure 4). This year, 72 new storylines were added to the database for teacher use. The website hosts over 30,000 users across 13 countries and is available in five languages. To date, the site has experienced over 1,000,000 hits since its creation.
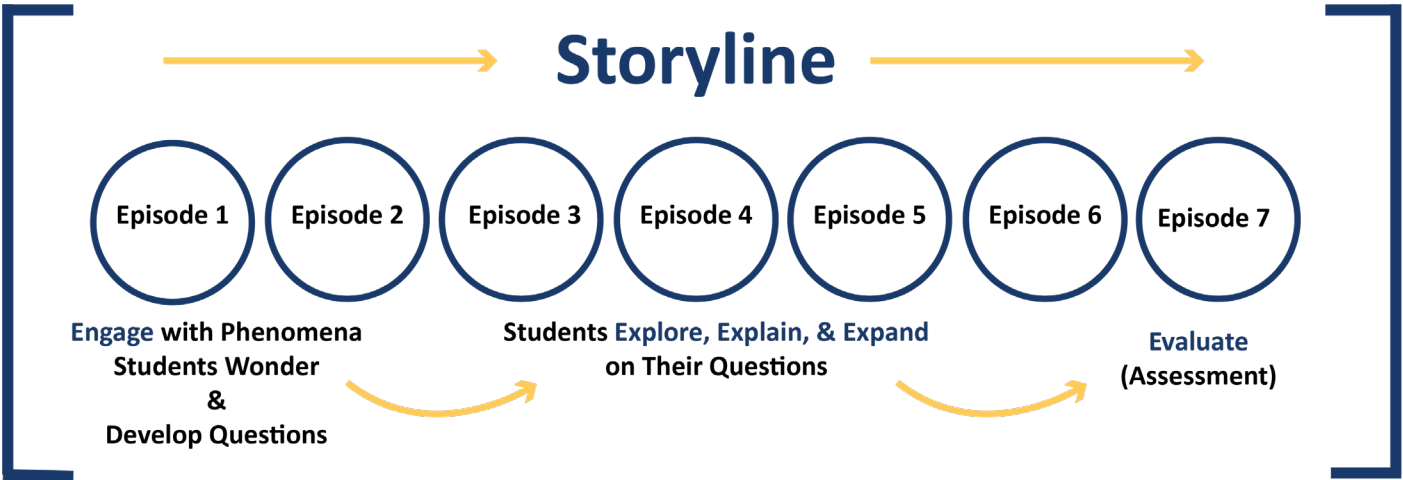

Storyline

Episode 1 — Episode 2 — Episode 3 — Episode 4 — Episode 5 — Episode 6 — Episode 7

Engage with Phenomena Students Wonder & Develop Questions

Students **Explore, Explain, & Expand** on Their Questions

Evaluate (Assessment)

Figure 4. SEEd Storylines are designed to include seven episodes that engage students with STEM-Centered Learning.

ELEMENTARY & SECONDARY MATH

Multiple programs have been implemented for math teachers that span K-12. New programs and resources include book studies, an online math course for teachers and parents, new resources to support personalized and standards-based learning, and numerous teacher professional learning opportunities. Additional information, programs, and professional learning opportunities can be found on the DSD Math website.
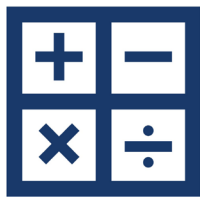
MATHEMATICAL MINDSETS COURSE

An online Mathematical Mindsets course taught by Jo Boaler and Carole Dweck, Stanford researchers, was offered to all DSD math teachers and parents. Approximately 300 individuals registered for this online, self-paced course. Title IV money was used to purchase the registrations. Feedback from participants that completed the course was very positive and ranked the course in the top five PD offerings that they had experienced. The goal of this initiative was to further shift mathematical mindsets to provide practical strategies and activities to help students learn and find the most effective ways to reach their full math potential.

PERSONALIZED AND STANDARDS-BASED LEARNING TOOLS

Teacher teams (K-12) have worked to curate high-quality, online educational resources, task-based resources that provide content for priority standards, high-level curriculum maps for each grade level, ACT Alignment of priority standards, and priority depth rubrics. All of these resources can be found on the DSD website and are available to the public.

COMPREHENSIVE MATH INSTRUCTION (CMI)

The CMI Framework was implemented in DSD to align teacher instruction with shifts in mathematical pedagogy. The framework instructs teachers on better teaching practices for student understanding. The CMI framework combines conceptual understanding, procedural fluency, math talk, and an application of knowledge to solve problems. The CMI framework was first implemented in DSD in 2016. Since 2016, DSD has integrated the CMI framework into 21% of elementary schools (13 elementary schools), providing a CMI experience for over 6,546 students. An additional 43% of administrators who have not adopted the CMI framework are interested in future integration at their location. This year, 168 CMI framework professional learning sessions were scheduled to help teachers shift their mathematical mindset and improve their teaching practices. These trainings occurred on a regular basis for the first year and will continue through year three of implementation. To assess the effectiveness of the CMI framework and training sessions, a new observational tool was developed for math coach use. This tool was used to effectively assess student behaviors relating to teaching practices. The survey was based on the Mathematical Teaching Practices (MTP) (Table 3). Currently, over 300 teacher observations have been conducted to bring awareness to current teaching practices. At least one MTP was evident in 70% of CMI classroom observations. Observational data supports the need for increased training in two areas: support of building procedural fluency based on conceptual understanding, and supporting students' productive struggle in learning mathematics. Neither of these were evident in 40-50% of classroom observations. This data will shape future training and highlights areas for improvement.

70%

of CMI classroom observations demonstrated evidence of the MTP's

PROFESSIONAL LEARNING

Teachers had the opportunity to participate in 35 different K-12 Math professional learning opportunities including virtual book studies, in-person training, and lesson studies.

8x8 MATH TEACHER LEADER PROGRAM

This year, 300 people from around the state applied to participate in the 8x8 Math Teacher Leader Program and 90 were accepted. Acceptance into the program provides three years of support for mathematical learning in the classroom as it attends to the Mathematical Teaching Practices (MTP). Each year two of the MTP's are chosen for emphasis. Teachers are able to attend professional learning opportunities, implement the MTP's, and self/peer reflect on their progress. The long-term goal is to shift the mathematical teaching pedagogy and continue to deliver high-quality mathematical instruction for students.

BOOK STUDIES

Over 500 K-12 educators participated in math book studies during the 2019-2020 school year. Books were provided free of charge to all interested teachers and parents. The book studies increased teacher collaboration, assisted in shifting current mathematical mindsets, and provided opportunity for teacher reflections.

> *"The question is not whether all students can succeed in mathematics but whether the adults organizing mathematics learning opportunities can alter traditional beliefs and practices to promote success for all."*
>
> -Principles to Actions: Ensuring Mathematical Success for All, NCTM, National Council of Teachers of Mathematics, 2014, p. 60.

Table 3. Effective Mathematical Teaching Practices
1. Establish mathematics goals to focus learning
2. Implement tasks that promote reasoning and problem solving
3. Use and connect mathematical representations
4. Facilitate meaningful mathematical discourse
5. Pose purposeful questions
6. Build procedural fluency from conceptual understanding
7. Support productive struggle in learning mathematics
8. Elicit and use evidence of student thinking
National Council of Teachers of Mathematics. (2014). Principles to actions: Ensuring mathematical success for all. Reston, VA.

Figure 5. State math competition

Figure 6. Ms. Jenning's kindergarten class discusses strategies that make counting more efficient.

COMPUTER SCIENCE

Davis School District has systematically infused computer science (CS) into all 61 elementary, 17 junior high, and 10 high schools (Figure 7). This ensures every student has access to a computer science education starting in kindergarten through 12th grade. This is a vital area of understanding for students to be productive in the modern world. Computer science builds on computer literacy, educational technology, digital citizenship, and informational technology. Davis School District's DESK Standards can be found on the DSD Computer Science website.

At the elementary level, over 41,000 students, taught by 72 computer science specialists, are receiving a minimum of 30 minutes CS education each week (Figure 7). At the secondary level, over 35,000 students have access to CS courses and 41% of students are currently enrolled in at least one of 21 CS courses (Figure 8, Table 4). DSD has seen a 75% increase in CS credit hours earned in 2016. Additionally, CS enrollment is five times greater than 2016. When evaluating student enrollment, data shows female enrollment has increased by 88% since 2016 when the program was initially implemented. Data supports efforts to increase CS course offerings and improve access to a CS education for all students.

In an effort to expand the CS initiative, a new curriculum was designed and includes over 400 computer science lessons and resources for teacher reference. A crucial aspect of CS education is access to technology. DSD currently provides over 106,000 electronic devices district-wide and has seen a 48% increase in the number of devices requested by teachers, staff, and students since 2016 (Figure 9). Additionally, the majority of schools offer a 1:1 device-to-student ratio, supporting equitable access for all students.

Since 2017, DSD has received over $632,555 in computer science grants to move this initiative forward. This funding has provided numerous resources, including the purchase of teacher check-out materials, 17 professional learning opportunities, two book studies, and a new curriculum. Purchased equipment includes multiple classroom sets of the following: Spheros, Bee-Bots, Microbits, M-Bots, Makey Makey's, coding activities, and Dash & Dot robots.
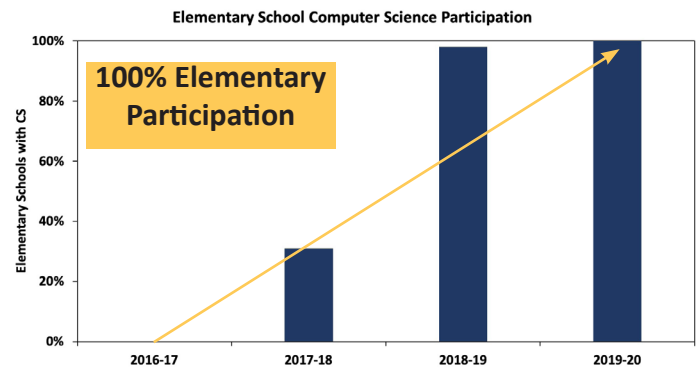
Figure 7. Elementary school participation in computer science since 2016. Today, 100% of DSD schools engage students in computer science education.
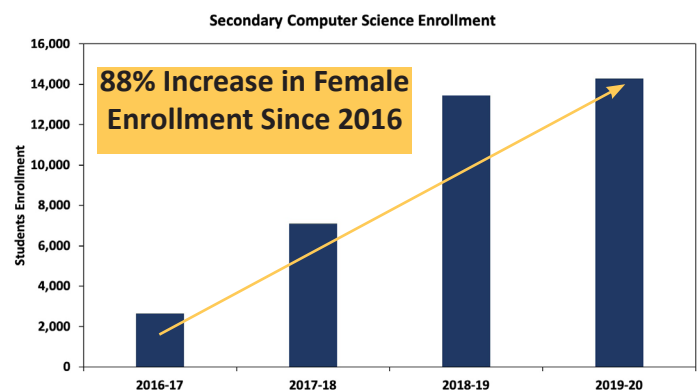
CS Enrollment is 5X Greater than 2016

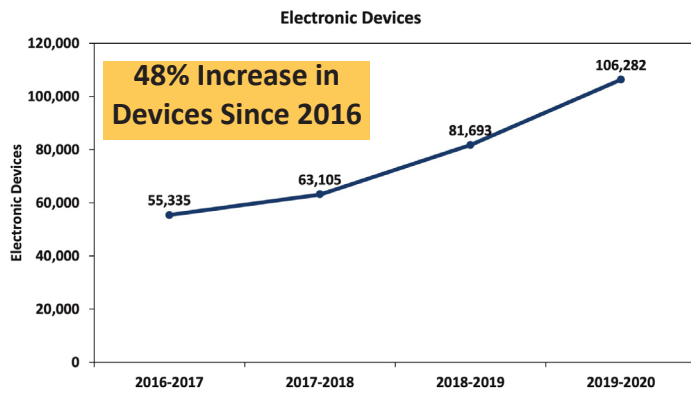*Figure 8. Secondary student enrollment in computer science courses since 2016.*

48% Increase in Devices Since 2016

Figure 9. Electronic devices owned by DSD since 2015.

1:1 Student to Device Ratio

Figure 10. Students at Sand Springs Elementary code a Bee-Bot to complete a computer science task.

Figure 11. Students at Sunset Elementary learn to use Ozobots.

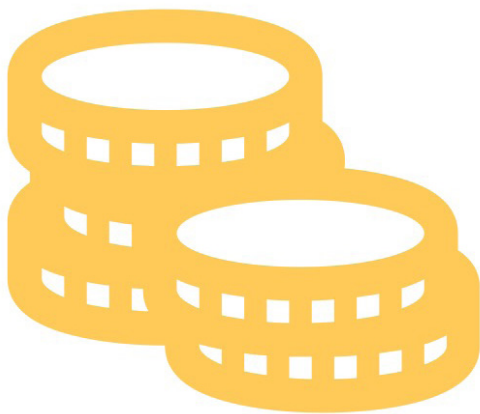| Table 4. Comprehensive list of computer science courses offered in Davis School District	
AP Computer Science	Exploring Computer Science 1
AP Computer Science Principles	Exploring Computer Science 2
CE Computer Science Principles	Gaming Development Fundamentals 1
Code to Success	Gaming Development Fundamentals 2
Computer Programming 1A	Mobile Development Fundamentals
Computer Programming 1B	PLTW Computer Science and Software Engineering
Computer Programming 2	PLTW Computer Science Applications
Creative Coding	Web Development 1
Cybersecurity and Ethical Hacking	Web Development 1 CE
Database Development	Web Development 2
Digital Literacy	

STEM-Centered Learning

SUPPLEMENTAL STEM PROGAMS

Supplemental STEM in DSD consists of comprehensive range of topics, including robotics, engineering, after-school programs and clubs, computer science, and general STEM activities. The purpose of supplemental STEM programs is to provide equitable access to a STEM education and offer a variety of programs that appeal to a broad range of student interests. Specific programs have been integrated into classrooms across the district to ensure every student develops problem solving and collaboration skills.

PROJECT LEAD THE WAY (PLTW)

PTLW is a supplemental curriculum that provides engaging, hands-on classroom experiences for students. The curriculum currently offers modules in engineering, computer science and newly aligned Next Generation Science Standards modules. The program has been adopted and implemented into 21 elementary schools. The PLTW program focuses on introducing students to the engineering design process to inspire creativity, critical thinking, problem solving, and collaboration. The PLTW program in DSD has been funded through a STEM Action Center grant providing more than $500,000 over a three-year period. This funding allows for up to ten new elementary schools to be added each year.

INFINID LABS

InfiniD Lab is a K-6 program that provides students the opportunity to creatively apply content from the classroom in a virtual setting. InfiniD delivers the content through game-like simulation modules that require team missions. Each team mission is designed to last approximately one hour and incorporates classroom content material that teachers customize to meet student learning outcomes. The InfiniD program focuses on student collaboration, communication, critical thinking, and problem solving. Currently, 29 elementary schools in DSD offer the InfiniD Lab experience. Over 460 teachers actively participated in running the InfiniD missions at their schools and 14,655 students experienced the missions. Overall, 2,360 InfiniD missions were flown, totaling 79,282 student hours exploring missions relating to classroom content and applying problem solving, collaboration, and communication skills.

14,655
K-6 Students Experienced InfiniD Missions

$560,000+
3-Year Grant to Fund PLTW, elementary engineering, and robotics

Figure 12. Sixth grade students engage in an InfiniD Mission.

MESA

Math, Engineering, and Science Achievement (MESA) is an after-school program offered specifically for underrepresented youth: economically disadvantaged, young women and ethnic minorities. The purpose of the club is to support underrepresented groups of students as they prepare for college and careers in science, math, and engineering. Davis currently supports 21 active MESA clubs (10 elementary, 8 junior highs, and 2 high schools). District wide, MESA clubs provided after-school STEM activities for 566 students in 2019-2020 school year. Currently, 23% of club members are minorities and 42% are female. Efforts will continue to be made to increase enrollment of underrepresented groups of students (Figure 14,15).

Figure 14. MESA club enrollment demographics by ethnicity

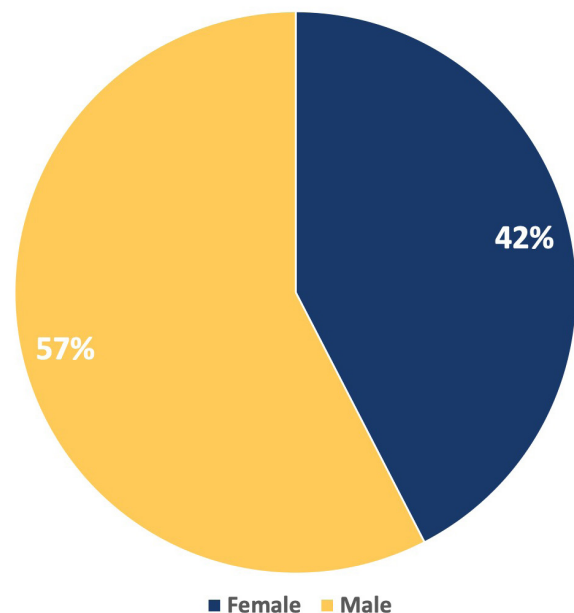*Figure 13. MESA students designed paper rockets at the district's Equity night.*

Figure 15. MESA club enrollment by gender

VEX ROBOTICS

VEX Robotics is a K-12 program that incorporates the engineering design process and provides students opportunities to design robots to complete specific tasks. To help fund the VEX Robotics program, DSD in partnership with Davis County Robotics Association, received a Robotics Education Foundation grant totaling $35,150. This year, DSD supported 190 robotics teams from 46 schools (Figure 17). Nearly 50% of all DSD elementary schools and 78% of secondary schools actively participate in VEX robotics. The number of students participating in the district has tripled since 2018, with approximately 750 elementary, 350 junior high, and 40 high school students participating in the program. Davis School District qualified 13 teams from eight schools to attend the VEX World competition held in April 2020 (four Elementary; four junior high; five high school).

Figure 16. K-12 students design robots to complete tasks for the PLTW and VEX Robotics programs.
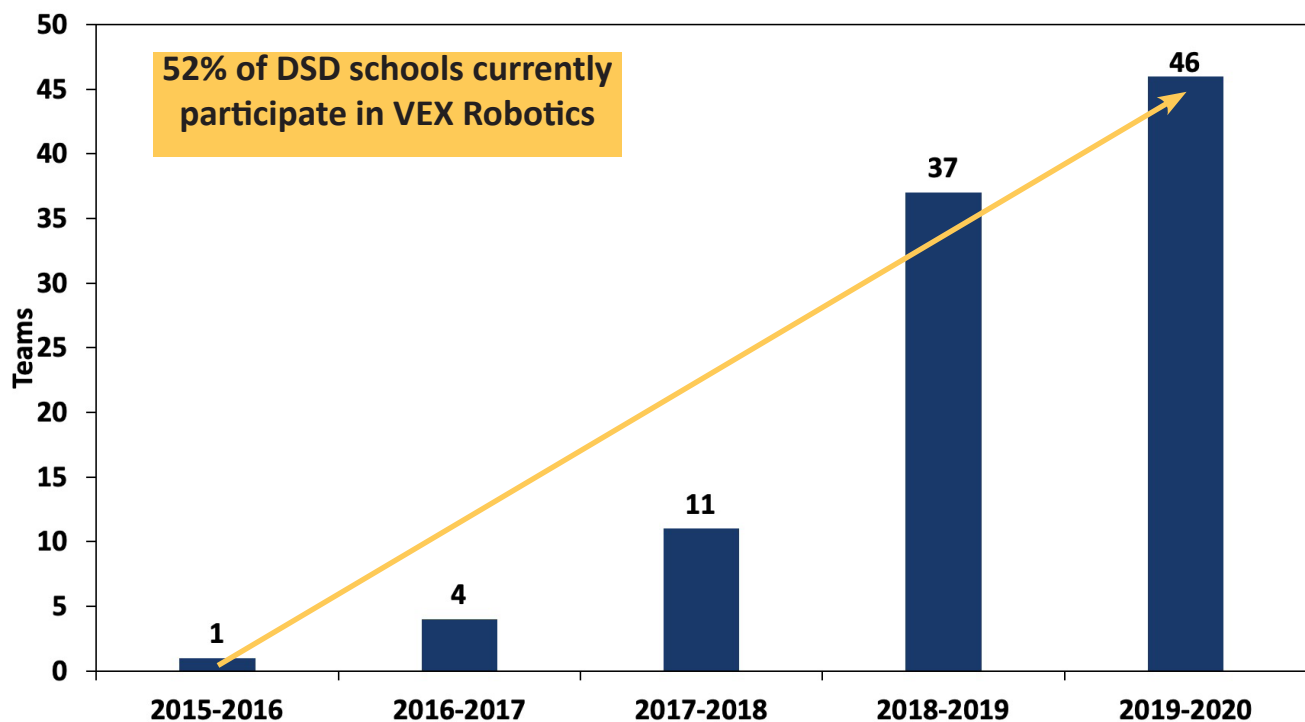
VEX Robotics Participation

52% of DSD schools currently participate in VEX Robotics

Figure 17. VEX Robotics team registration for DSD from 2015-2020. Today 52% of DSD schools participate.

STEM-Centered Learning

COMPUTER SCIENCE PREP SPECIALISTS

The purpose of the CS Prep Specialist program is to ensure every elementary student has access to a CS education starting in kindergarten through sixth grade. This is a vital area of understanding for students to be productive in the modern world. Computer science prep specialists provide students a minimum of 30 minutes CS education each week aligned to the new state standards. The new CS curriculum is being utilized by the CS Prep Specialists across all 61 elementary schools and offers over 400 lessons, activities, and resources for teacher use. In a recent district survey, 70% of CS teachers reported using the curriculum three or more times per week, and their overall time to prepare for lessons was significantly reduced from previous years. Currently, DSD employs 72 CS Prep Specialists throughout the District. The CS prep period ensures equitable access to computer science education for all students. This year, seven professional learning opportunities were provided for teachers to gain new knowledge and skills, collaborate with other prep specialists, and improve teaching strategies.

STEM PREP TIME SPECIALISTS

The STEM Prep Specialist program provides students with additional STEM learning opportunities to aid in the development of necessary skill such as wonder, problem solving, and sense making. Prep specialists work with students in a classroom setting for 30-50 minutes once a week. This additional STEM exposure helps students to innovate, collaborate, communicate, and prepare for a self-sustaining life. Currently, there are 25+ STEM Prep Specialists throughout the district. The prep period ensures equitable access to STEM learning opportunities for all students. This year, four STEM prep professional learning opportunities were provided for teachers to gain new knowledge and skills, collaborate with other prep specialists, and improve teaching strategies.

30-50 Minutes
of Elementary CS or STEM Instruction Every Week

STEM OLYMPIAD

The Science Olympiad is a national organization dedicated to improving the quality of K-12 science education. The Science Olympiad creates a passion for learning science by supporting tournaments with an emphasis on teamwork and a commitment to excellence. This year, 300 students in grades 7-9 participated in the Jr. High STEM Olympiad, competing in robotics, engineering, math, and science challenges.

The elementary Science Olympiad is developed by teachers in Davis School District. It is a competition for 4th-6th graders which seeks to develop STEM-based skills in our students. The events change regularly and are broken into three science and engineering events and three math events (Table 5). This year, the event was cancelled due to COVID-19, but typically 1,500 elementary students participate in the STEM Olympiad.

Figures 19. Students designed paper roller coasters at the Junior High STEM Olympiad.

Table 5. Elementary STEM Olympiad Events	
MATH	**SCIENCE**
Logic Grid Puzzles	Circuit Creation
Krypto	Paper Rockets
Soma Cubes	Create from SCRATCH

"The benefits of participating in Science Olympiad competitions are many:

Application of scientific, engineering and math principles
Hands-on learning
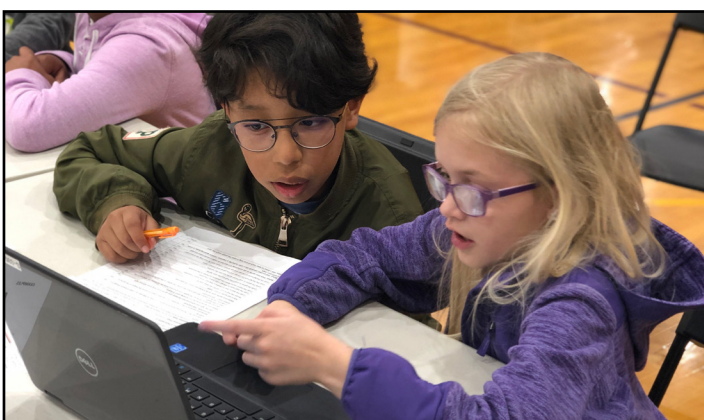*Creative thinking and problem-solving skills*
Leadership and teamwork skills
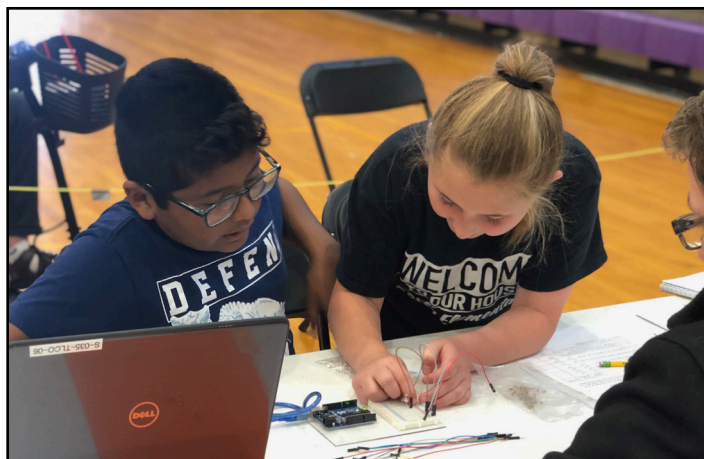*Exploring career possibilities in science & engineering"*
-Utah Science Olympiad

Figures 20. Students completed coding challenges at the STEM Olympiad.

Figures 21. Students completed circuitry challenges at the STEM Olympiad.

STEM-Centered Learning

STEM FAIR

The STEM Fair provides students an opportunity to apply the scientific method and/or engineering design processes. Students design and conduct an independent research project around a topic of their choice. Results of each student's research project are presented at a school, district, and regional science fair competition. Davis School District hosted the district-wide competition on February 24, 2020. This event included 133 elementary and 150 secondary students from 38 schools. Students that placed 1st, 2nd, or 3rd qualified to participate in the regional Richey Science and Engineering Fair held at Weber State University.

Figure 22. District STEM Fair held at the Davis Conference Center

Figure 23. District STEM Fair held at the Davis Conference Center

INTERMOUNTAIN SEAPERCH CHALLENGE

SeaPerch is an innovative underwater robotics program that equips students and teachers with the resources and curriculum to build an underwater remotely operated vehicle. Students must creatively design a robot to complete specific underwater tasks in a given amount of time. The program focuses on implementing the engineering design process, problem solving, collaboration, critical thinking, and creativity. This year, 200+ students from 16 schools participated in the Intermountain SeaPerch challenge, competing against students from Davis, Ogden and Weber School Districts. Students designed robotics to perform underwater tasks such as retrieving sunken trash, transporting an item from the middle of the pool to the side, and maneuvering through obstacle courses. Awards included four DSD teams qualified to compete in the national competition held in April 2020 at the University of Maryland. The Intermountain Seaperch Challenge was featured in the *Standard Examiner.*

Figure 24. Students competed at the Intermountain SeaPerch Challenge with underwater robots.

Standard Examiner Story:
https://www.standard.net/news/education/northern-utah-school-districts-come-together-to-organize-underwater-robotics-competition/article_05b84d02-accd-5521-bc13-00846fcac4cd.html

COMMUNITY PARTNERSHIPS & SUPPORT

Together we will fuel the future sense makers, problem solvers, and innovators who will change the world for the better.

Community partnerships and support are a vital part of STEM education in DSD. Community support provided numerous volunteers at events, competitions, and programs that enhanced student experiences. Generous sponsors funded the Northern Utah STEM Career and College Exposition and the Junior High STEM Olympiad. Community partnerships also included field trip opportunities that provided students hands-on, real-world experiences. Currently, three field trips are available to DSD students and are free of charge: IMAX movie and Planetarium visit, Davis Goes Green, and STARBASE. Financial support included $419,060 in grants awarded to the STEM Department for the 2019-2020 school year. These grant funds provided science, math, computer science, and engineering programs and resources throughout the district.

FIELD TRIPS

Davis partnered with industry to provide students educational field trips and learning opportunities. Currently, DSD offers three field trip opportunities to schools by providing substitutes, bussing, and admission fees: Davis Goes Green, IMAX Movie and Planetarium, and STARBASE. Overall, 19,336 students experienced at least one of the previously described field trip opportunities during the 2019-2020 school year.

19,336 K-6 students experienced sponsored field trips

DAVIS GOES GREEN

The purpose of Davis Goes Green is to promote understanding of water and waste management in Davis County and the surrounding areas. Weber Basin Water Conservatory, Wasatch Integrated Waste Management District, South Davis Sewer District, and DSD have partnered together in an effort to show students first-hand how water is cleaned and waste managed. The program provides completely free field trips for our schools to visit these facilities and talk with experts. These field trips directly support our DESK standards and provide a relevant real-world scenario to solidify our students' understanding of the world around them.

IMAX & PLANETARIUM

Public schools are offered free admission to the Clark Planetarium to experience science and engineering exhibits, the Hansen Dome, and an educational IMAX movie.

STARBASE

STARBASE is a Department of Defense program facilitated by Hill Air Force Base (HAFB) that offers hands-on STEM field trips for fifth grade students. The program includes five days of discovery-based learning, where students attend one day a week for five weeks. Content areas include chemistry, physics, engineering, energy, math, technology, seismology, and geology. Students are provided the opportunity to collaborate and problem solve while working through different STEM principles and concepts. Each year approximately 1,350 students from 16 schools in DSD participate in the program. An additional partnership has been made with Hill Air Force Base to make this a completely free experience for DSD schools. HAFB pays for the five field trip days and DSD provides the buses. HAFB expanded their facilities to accommodate additional students in future years.

Figure 25. Students visit the South Davis Sewer District as part of the Davis Goes Green field trip program.

VOLUNTEERS AT STEM EVENTS

The STEM Department received support from 525+ volunteers for numerous STEM events during the 2019-2020 SY. Events included:

- STEM Expo
- STEM Fair (6-8th grade, 9-12th grade)
- STEM Olympiad
- Intermountain SeaPerch Challenge

PROGRAMS AND EVENTS

NORTHERN UTAH STEM EXPO

The Northern Utah STEM Career and College Exposition was created to foster student enthusiasm for STEM careers. The event also provides students with opportunities to explore STEM fields, investigate educational pathways, and to collaborate with local STEM-based business and industry. The event was hosted at the Davis Conference Center and featured 50+ booths with hands-on activities by local businesses, STEM-based industries, applied technology colleges, community colleges, and universities.

More than 800 high school students were given the opportunity to interact with industry representatives, explore potential STEM careers, and attend panel sessions. An evening session with approximately 4,500 attendees provided a free STEM Family Night for teachers, parents, and family members.

Figure 26. Northern Utah STEM Expo was filled with community partnership booths. Each booth provided STEM learning oopportunities for students and families.

CHEVRON FUEL YOUR SCHOOL

The Chevron Fuel Your School Program is available to help fund classroom projects for grades K-12 that are posted on DonorsChoose.org. The program donated $1 per eight (or more)-gallon purchase at a participating Chevron or Texaco stations. Funding was available to support STEM learning in the classroom. This year, 167 projects were funded, and 16,702 students were impacted.

167 STEM Projects Funded

=

16,700+ Students Impacted

4,500+
community members attenced the free family event to learn about STEM careers and educational opportunities

CTE PATHWAYS PROGRAM

The CTE Career Pathway is a rigorous program of study to assure strong academic and technical preparation, providing students with critical learning and hands-on skills. Students can enroll in the Pathways program beginning in 9th grade. Specific courses are approved for credit by local universities and technical colleges.

18,811
Students enrolled in CTE courses

42%
Concentrated in a CTE Career Pathway

37
Industry-recognized tests and certifications available to DSD students

The CTE Career Pathway program enrollment has increased from 41,234 to 45,778 students since 2018. The increased enrollment can partially be attributed to greater student interest in CTE Courses to prepare for future employment opportunities.

Davis School District CTE Career Pathways Preparing Students for College & Career Readiness	
Agriculture, Food & Natural Resources ➢ Agricultural Production Systems ➢ Food Science, Dietetics & Nutrition ➢ Plant Science	**Health Science** ➢ Emergency Medical Services ➢ Nursing Services ➢ Biotechnology
Architecture & Construction ➢ CAD Architectural Design ➢ Interior Design ➢ Construction & Structural Systems - Carpentry	**Hospitality & Tourism** ➢ Culinary Arts ➢ Hospitality & Tourism
Arts, Audio/Visual Technology & Communications ➢ Fashion, Apparel & Textiles ➢ Commercial Art ➢ Commercial Photography ➢ Digital Media ➢ Graphics Printing	**Information Technology** ➢ Cybersecurity ➢ Information Technology Systems ➢ Programming & Software Development ➢ Web Development
Business, Finance & Marketing ➢ Accounting & Financial Operations ➢ Customer Service & Management ➢ Entrepreneurship ➢ Office / Administrative Support ➢ Marketing & Sales	**Manufacturing** ➢ Welding ➢ Advanced Manufacturing – Cabinetmaking/Woodworking
Education & Training ➢ Pre-K Early Childhood Education ➢ K-12 Teaching as a Profession	**Transportation, Distribution & Logistics** ➢ Aviation ➢ Automotive – Service Technician
Engineering & Technology ➢ Mechanical Engineering ➢ Robotics	

HACKING STEM

Hacking STEM is a program for educators that provides inquiry and project-based activities for the classroom. The curriculum and included activities focus around visualizing data across science, technology, engineering, and math (STEM). Included projects range from one hour to three weeks and integrate data science, electrical engineering, mechanical engineering, and software engineering. A Microsoft Hacking STEM Library is included that provides downloadable, hands-on, teacher-tested projects and activities that use everyday materials to make STEM affordable, accessible, and fun for everyone.

Summer learning opportunities are available for DSD teachers to be introduced to the Hacking STEM curriculum and prepare for the coming school year. This year, 11 teachers participated and over 2,000 students were impacted by this partnership. For the 2020-2021 school year, Hacking STEM will be expanded to 20 additional schools, doubling the number of students currently experiencing the program.

2,000+
Students participated in the Hacking STEM program during the 2019-2020 school year.

Figure 27. Students particpated in the Hacking STEM lesson to design robotic hands out of straws.
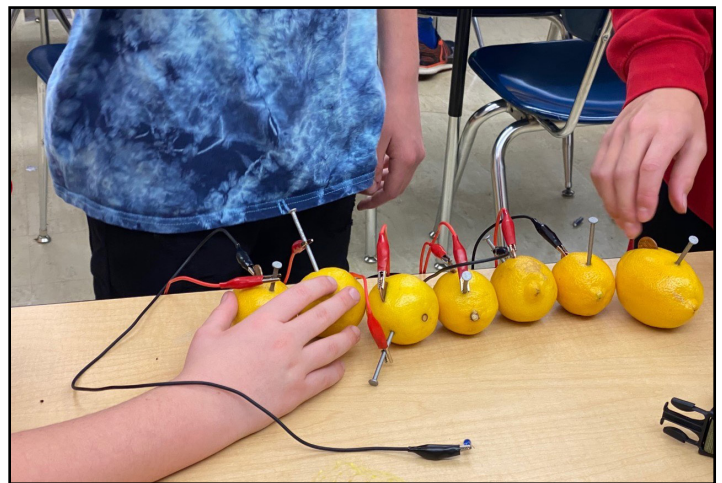
Figure 28. Students particpated in the Hacking STEM lesson to build batteries out of lemons.

IMPACTS OF STEM INITIATIVES

DSD's Ultimate Goal: Students have the skills to innovate and thrive in their future while being able to work through unknown real-world problems collaboratively. This will allow students to create self-sustaining lives.

Efforts to increase STEM-Centered Leaning in DSD have included new curriculum, teacher resources, professional learning opportunities, additional STEM courses, and equitable access for all students. Together, these efforts have increased enrollment in advanced STEM courses, increased standardized testing scores, and resulted in highly qualified teachers to educate students.

EQUITABLE ACCESS

Equitable access to a STEM education is a priority in DSD. To ensure all students can access materials, content, and resources, the following have been implemented:

- 1:1 Electronic Device to Student Ratio at the majority of schools
- Computer Science Initiative: CS education for all elementary students and a new comprehensive curriculum. At the elementary level, computer science and STEM specialists have been hired at all 61 elementary schools. The prep specialist position provides STEM-related instruction and experiences for all 41,541 elementary students in DSD. The computer science and STEM initiatives are providing equitable access for all students and engaging students in wonder, sense making, and problem-solving activities in kindergarten through sixth grade.
- SEEd Storylines: Free high-quality curriculum and resources for science teachers. The website supports over 30,000 world-wide users and has experienced over 1,000,000 site hits since its development. This resource provides access for all teachers.
- Advantage Math Curriculum: Free high-quality curriculum and resources available for all teachers.

41,541 Elementary Students Receiving a Computer Science Education in Davis School District

TEACHER ENDORSEMENTS

STEM is a vital piece of the elementary and secondary school experience that requires qualified teachers to facilitate learning. Currently, 40% of all DSD teachers have earned a STEM-related endorsement, and this number increases each year with new cohorts. The goal of the endorsement program is to enhance educators' understandings of key concepts in STEM areas to better serve the needs of students in the 21st century and is geared toward providing professional learning and best practices for teachers. Currently, 1,094 K-12 teachers have earned a STEM-related endorsement. Additionally, 643 STEM teachers are employed to facilitate 7th-12th grade secondary courses.

40%

1,094 STEM-Endorsed Teachers

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40% of all DSD teachers have earned a STEM-related endorsement

STEM-Centered Learning
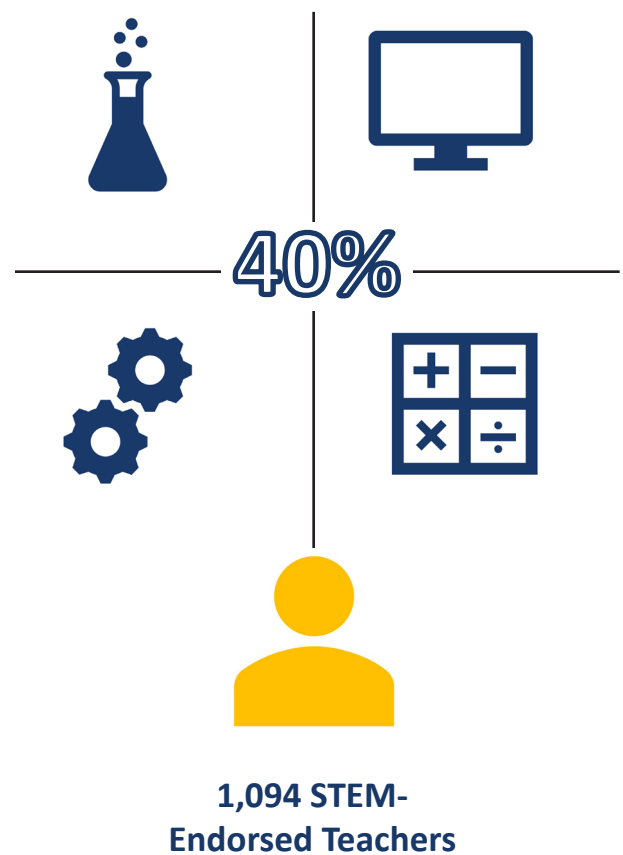
ENROLLMENT

GENERAL ENROLLMENT

Davis School District offers 238 secondary STEM courses, 43 of which are advanced (Advanced Placement [AP], Concurrent Enrollment [CE], Honors, Accelerated). Presently, 37,100 secondary students are enrolled in at least one STEM-related course. General STEM course enrollment has increased by 19.5% since 2015, but enrollment changes are closely aligned with district growth patterns. A focus on STEM enrollment for beyond the required courses, such as advanced STEM courses and Special Education Services (SPED) enrollment, demonstrates a student interest increase since 2015 (Figure 29).

Student enrollment in advanced STEM courses (AP, CE, Honors, Accelerated) has increased by 20% over the last 5 years, totaling 6,721 enrolled students for the 2019-2020 school year. Advanced technology, engineering, and CTE courses have shown the greatest increase in enrollment (52%), followed by math (43%) courses (Figure 30).
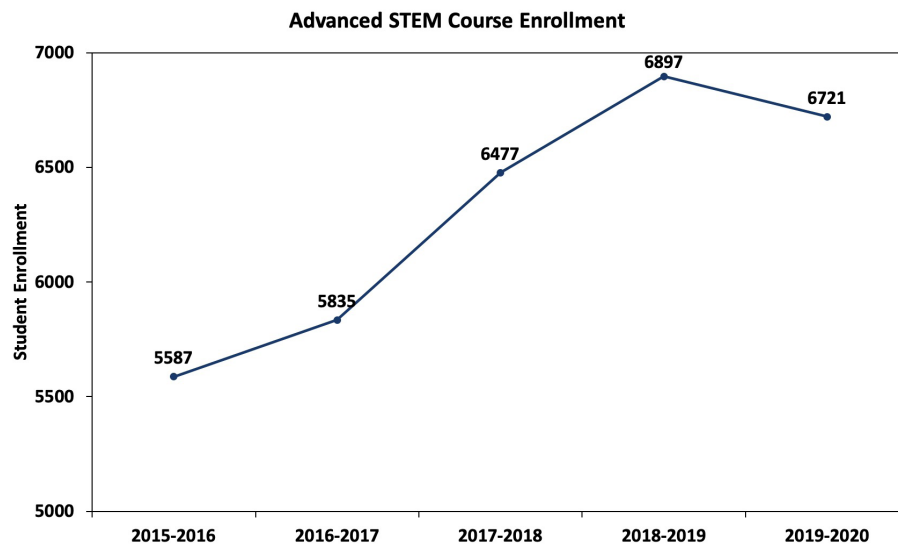

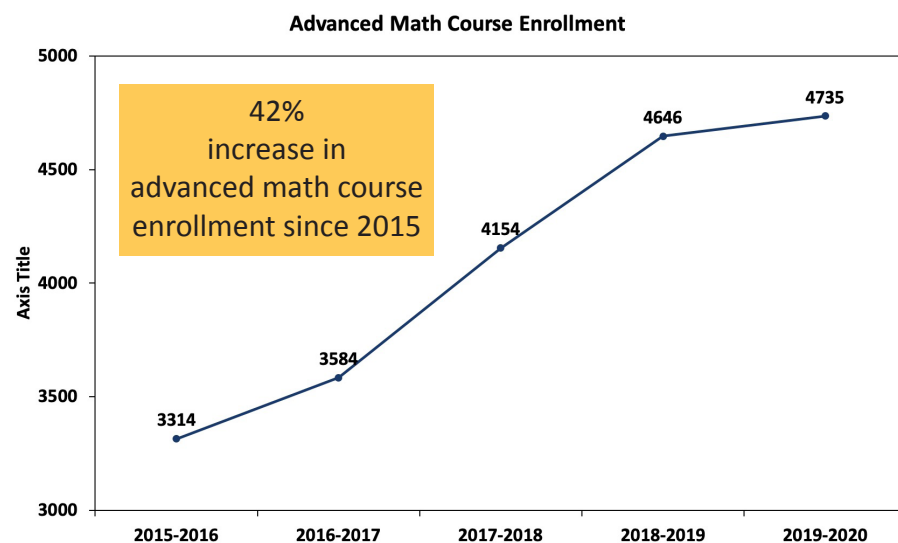*Figure 29. Advanced enrollment in DSD since 2015.*

Figure 30. Advanced math enrollment in DSD since 2015.

STEM-Centered Learning

MINORITY ENROLLMENT

Data indicate low-income student enrollment has increased for general math (15%) and engineering and technology (50%) courses since 2015. Non-Caucasian student enrollment has increased in science (9%), math (27%), and engineering and technology (62%) courses since 2015. Female student enrollment has also increased in both math (19%) and engineering and technology (52%) courses since 2015.

Advanced STEM course enrollment shows increases for minority groups since 2015 (Figure 31). Overall, approximately 20% of students taking a STEM course are enrolled in an advanced option, which is beyond graduation requirements. Advanced math courses have shown a 76% increase in minority student enrollment and an overall 43% increase in total student enrollment since 2015. Additionally, advanced engineering and technology have shown an increase in minority student enrollment and overall a 51% increase in student enrollment.
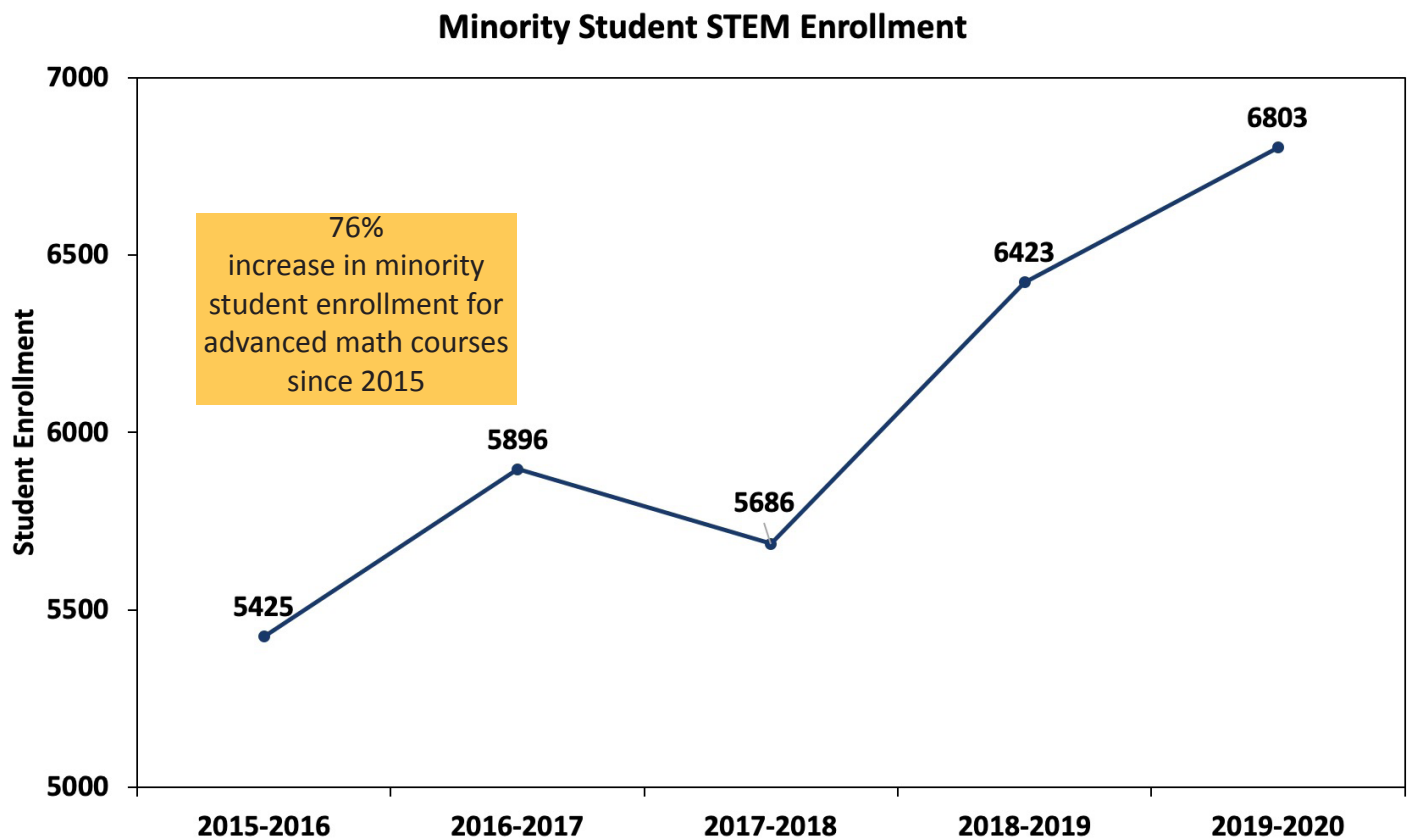
Minority Student STEM Enrollment

76% increase in minority student enrollment for advanced math courses since 2015

Figure 31. Minority student enrollment in STEM courses from 2015-2020.

STUDENTS RECEIVING SPECIAL EDUCATION SERVICES

Together, the STEM and Special Education departments strive to work with students requiring special education services to promote each student's success and well-being as they prepare for future endeavors. Evidence-based practices are utilized to provide access, skills, knowledge, independence and opportunity to reach full potentials and participate successfully in the least restrictive environment possible.

Enrollment for students receiving special education services has increased by 13% since 2015 (Figure 32). Student enrollment in engineering, technology, and CTE courses has increased by 25% since 2015 and remained similar for math and science courses. Efforts will be made to continue to increase access and appeal of STEM courses to students receiving special education services.
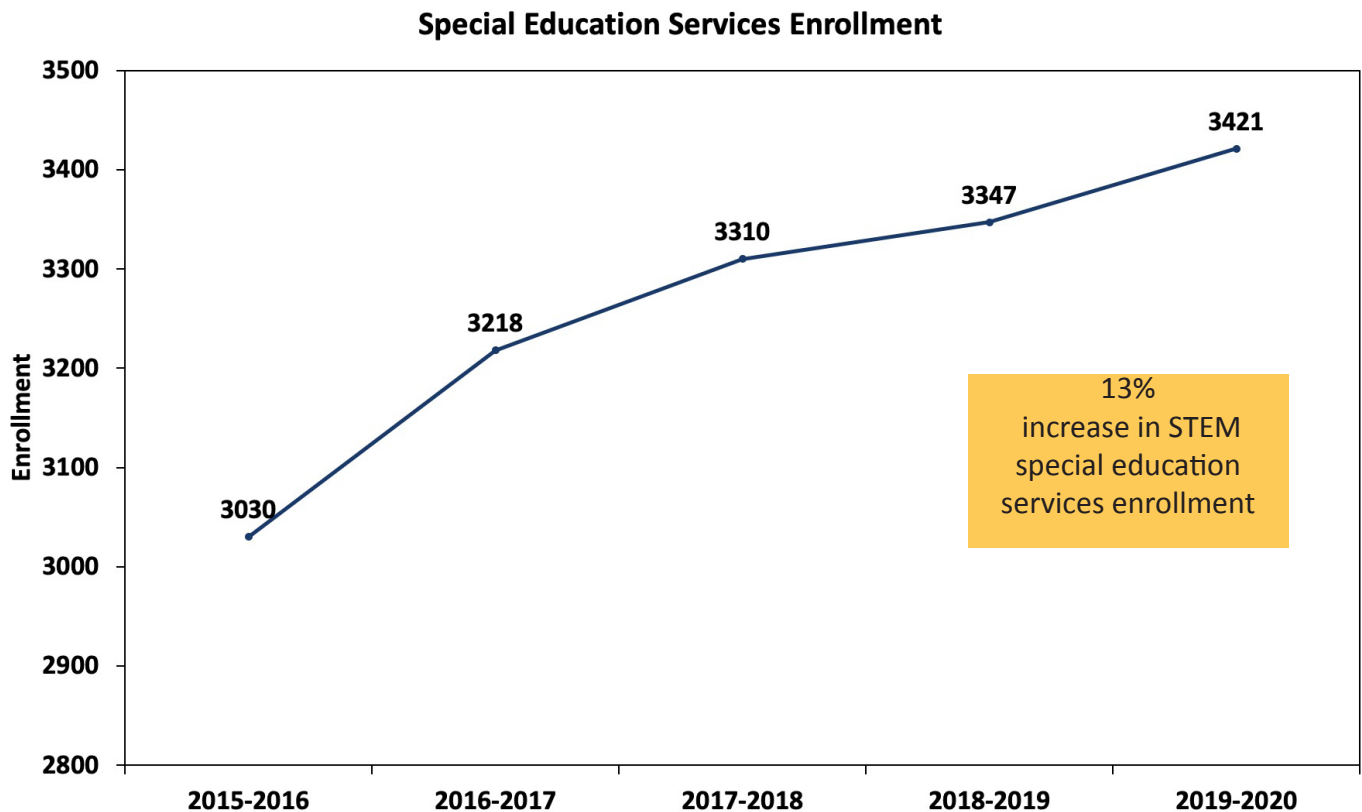
Special Education Services Enrollment

Figure 32. Special education student services enrollment from 2015-2020.

STANDARD TESTING PERFORMANCE: ACT

The objective of the ACT test is to measure a high school student's readiness for college and provide colleges with one common data point that can be used to compare all applicants. This year, 2285 students completed the ACT. The average composite ACT score in DSD has increased 17.5% since 2015 (Figure 33). It is important to note that the 2019-2020 school year was shortened due to COVID-19 and soft closures, resulting in a smaller student population taking the ACT.
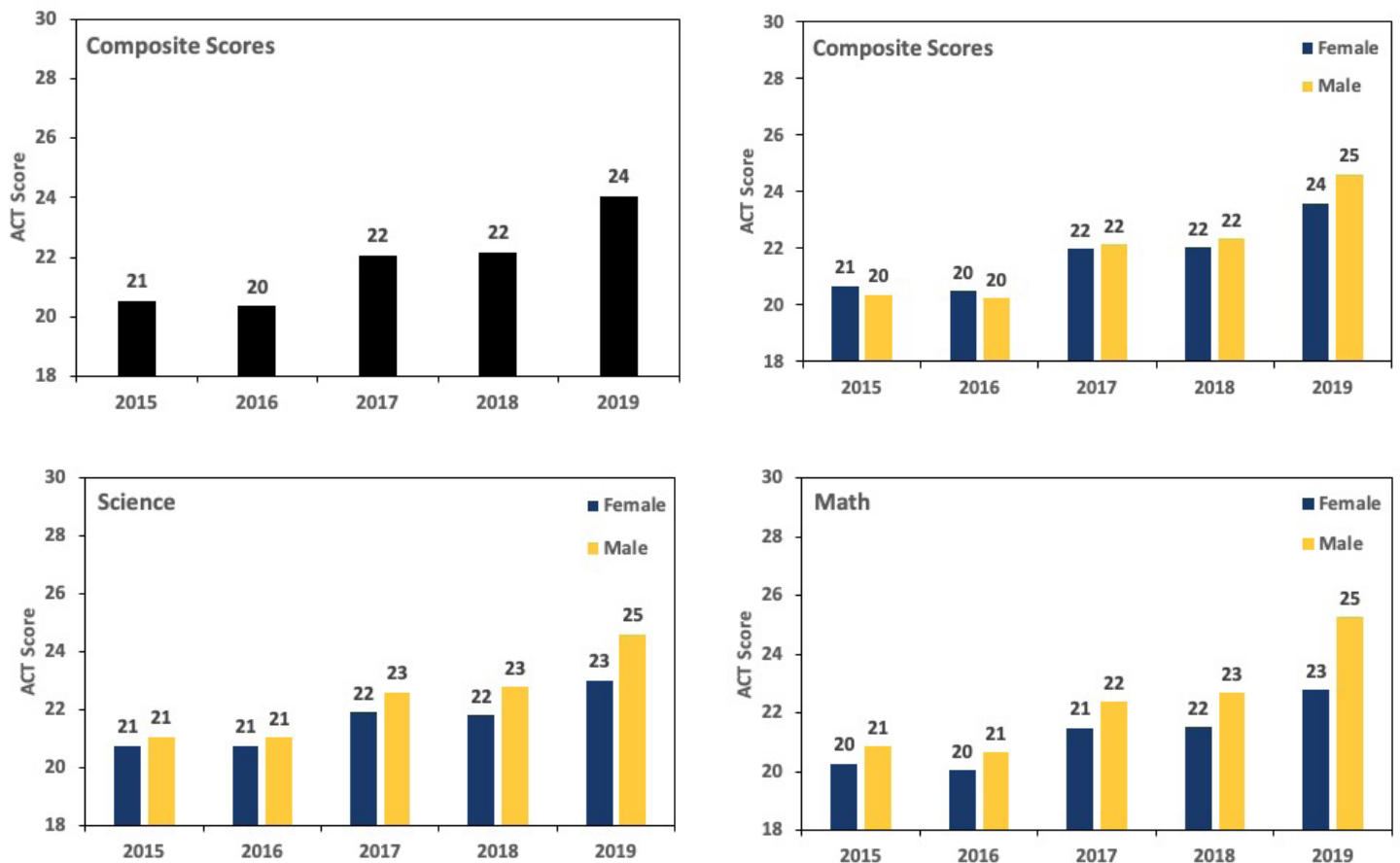
ACT Scores: 2015-2020

Figure 33. Student ACT scores for 2015-2019 school years. Composite ACT score for students in Davis School District, Composite ACT scores separated by gender, Science ACT scores separated by gender, and Math ACT scores separated by gender.

STEM-Centered Learning

RESOURCES

STEM in Davis District happens every day in our core classes and is supplemented with many extra-curricular programs. The goal is to give every student at every school the opportunity to engage in STEM learning every day. This is a district-wide effort from teachers, prep specialists, administrators, and the community. Together we will fuel the future sense makers, problem solvers, and innovators who will change the world for the better.

DSD is committed to continuing STEM education and supporting teachers and the community. Future efforts will focus on additional resources and communication to teachers, students, and the community, specific STEM-Centered Learning professional learning opportunities, and data collection.

PARENTS & STUDENTS

Parents can stay informed about educational programs, curriculum, events, and more at the links below. For additional questions please contact the Teaching and Learning Department.

Elementary Science
- STEM Fair
- STEM Olympiad
- Summer Science Camp

Secondary Science
- STEM Fair
- Science Olympiad

Elementary Math
- Parent Resources

Secondary Math
- Parent Resources

Computer Science
- Coding Apps & Sites
- Keyboarding

Supplemental STEM
- MESA
- VEX Robotics
- InfiniD Learning
- Project Lead the Way

EDUCATORS & ADMINISTRATORS

The purpose of the Teaching and Learning Department is to provide service and support for educators to provide a high-quality educational experience for students. Resources, tools, and information for educators and administrators can be found at the links below.

Standards
- Math DESK Standards
- Science and Engineering DESK Standards
- Computer Science DESK Standards

Curriculum Resources
- Elementary Science
- Secondary Science
- Elementary Math
- Secondary Math
- Computer Science

Events, Programs, & Professional Development
- Science Professional Development
- Math Professional Development
- Science Equipment Check-Out
- Computer Science Equipment Check-Out
- Engineering is Elementary Kit Check-Out
- Story Design: Innovative STEAM Activities

Figure 34. Students work together to create a domino chain.

ADDITIONAL RESOURCES

STEM Newsletter:
Distributed monthly to communicate initiatives, resources, ideas, and more

STEM Website:
https://www.davis.k12.ut.us/academics/teaching-and-learning-homepage

Instagram and Twitter:
Follow us on social media for live updates
@Teach_Learn_DSD

STEM Video:
Watch our video to see STEM-Centered Learning in action and understand what STEM means in Davis School District

Professional Learning
Contact your content specialist to learn about upcoming learning opportunities

Posters:
Check your school for new STEM-Centered Learning posters

Top 5 Digital Math Tools

1. TEACHER DESMOS

TEACHER.DESMOS.COM | K-12 | FREE

DESMOS CONTAINS A BANK OF HIGH-QUALITY LEARNING EXPERIENCES ON EVERYTHING FROM CONIC SECTIONS TO ADDING WHOLE NUMBERS WITH THE OPTION TO CREATE YOUR OWN.

2. GEOGEBRA

GEOGEBRA.ORG | K-12+ | FREE

GEOGEBRA CONTAINS A LIBRARY OF HIGH-QUALITY LEARNING EXPERIENCES ON EVERYTHING FROM DIFFERENTIAL EQUATIONS TO FRACTIONS WITH THE OPTION TO CREATE YOUR OWN AND SHARE WITH OTHER MATH EDUCATORS.

3. GLENCOE MANIPULATIVES

HTTP://WWW.GLENCOE.COM/SITES/COMMON_ASSETS/MATHEMATICS/ EBOOK_ASSETS/VMF/VMF-INTERFACE.HTML/ | K-12 | FREE

GLENCOE MANIPULATIVES IS A COMPLETE LIBRARY OF VIRTUAL MATH MANIPULATIVES INCLUDING ALGEBRA TILES, ATTRIBUTE BLOCKS, BASE TEN BLOCKS, TWO COLOR COUNTERS AND MORE!

4. DREAMBOX*

DREAMBOX.COM | K-8 | PAID

DREAMBOX LEARNING PROVIDES STANDARDS-ALIGNED CURRICULUM IN AN ONLINE MATH PATHWAY THAT ADAPTS BASED ON HOW STUDENTS INTERACT WITH MATH MANULIPULATIVES.

5. ST MATH*

STMATH.COM | K-8 | PAID

ST MATH IS A STANDARDS-BASED LEARNING PLATFORM THAT PROVIDES ADAPTIVE AND VISUAL MATH-BASED CRITICAL THINKING AND PROBLEM-SOLVING PUZZLES.

5A. BRILLIANT

BRILLIANT.ORG | 3-12 | PAID

BRILLIANT BILLS THEMSELVES AS THE PRODUCT THAT TEACHES YOU HOW TO LEARN TO THINK! BUILD QUANTITATIVE SKILLS IN MATH, SCIENCE, AND COMPUTER SCIENCE WITH FUN AND CHALLENGING INTERACTIVE EXPLORATIONS.

*PAID BUT AVAILABLE THROUGH THE STEM AC DIGITAL LICENSE GRANT LINDSEY HENDERSON, K-12 MATH SPECIALIST 11.19
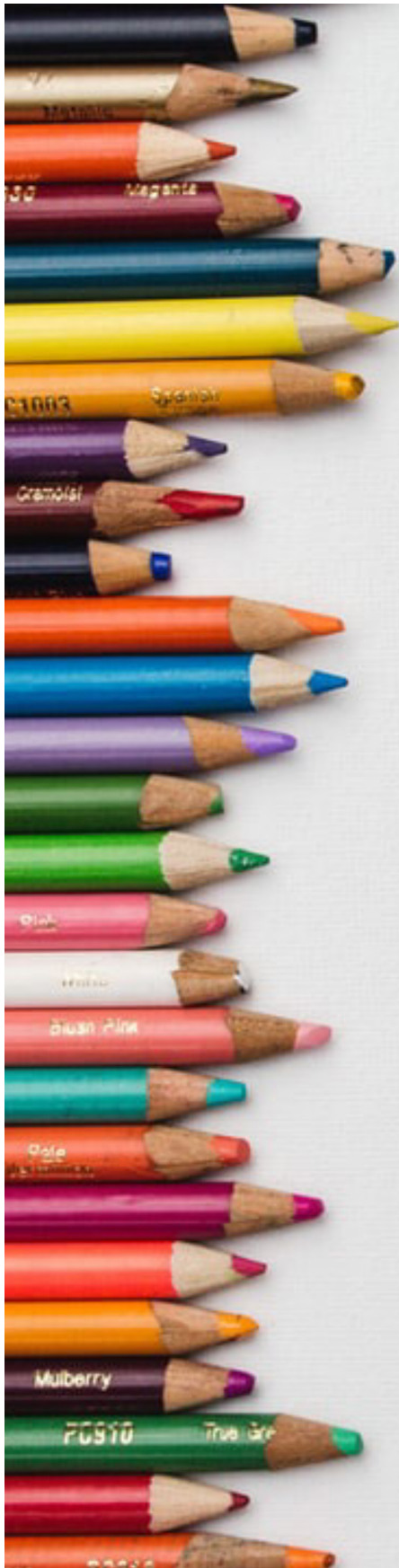
K-6 Science Digital Tools

1. Seedstorylines.org

This is a full and free district curriculum for teachers. It includes a storyline matrix, storyboard presentation, student journal, material prep list, and materials list. It explicitly uses the three dimensions of science and engineering instruction to help students wonder, sense make, and problem solve. Each storyline gives relevance to each activity by setting it in a narrative that drives the understanding of a big idea. It moves lessons away from the traditional teaching method of moving from topic to topic, like a textbook does, instead moving the student through an inquiry-based narrative with a set outcome. Rather than just doing something that pertains to the topic, students are driven by answering questions and engaging with phenomena. Each episode adds to the student's progress of deeper understanding. Coherency comes from the perspective of an inquiring student, engaged in a relevant learning experience

2. Mystery Science

Mystery Science provides ready-made science lessons aligned to the Utah SEEd Standard. Teachers select the lesson they would like to use and simply hit "play." Each lesson is organized around a key question (e.g. "What happens when plates move along a fault?"). The lesson starts with a short introductory video, laying out the lesson's key question. The video is followed by discussion questions for the class. Finally, the lesson ends with a hands-on activity designed to help students find the answer to the key question. Each activity comes with instructions and a list of materials needed.

3. Project Lead the Way

This program empowers students to adopt a design-thinking mindset through compelling activities, projects, and problems that build upon each other and relate to the world around them. Project Lead the Way is unrolling a full science curriculum this 2020 summer. Teachers who have access to Project Lead the Way will have full access to their curriculum. However, materials may need to be purchased for the different modules.

4. Gizmos

Gizmos are quality interactive math and science simulations for grades 3-12. There are over 400 simulations that provide students the opportunity to interact with science and math in a very student-centered way. It allows students to manipulate systems and to make sense of science in ways that would otherwise be impossible.

5. McgrawHill Inspire

This program is a 7-8th grade all inclusive science platform. It contains digital labs, virtual field trips, and full curriculum for all major science subject areas. It is built in a semi-phenomena based model and has lessons for all of the major standards. We have an adoption running through fall of 2021.

6. STEM Scopes

Full STEM curriculum matching all NGSS standards
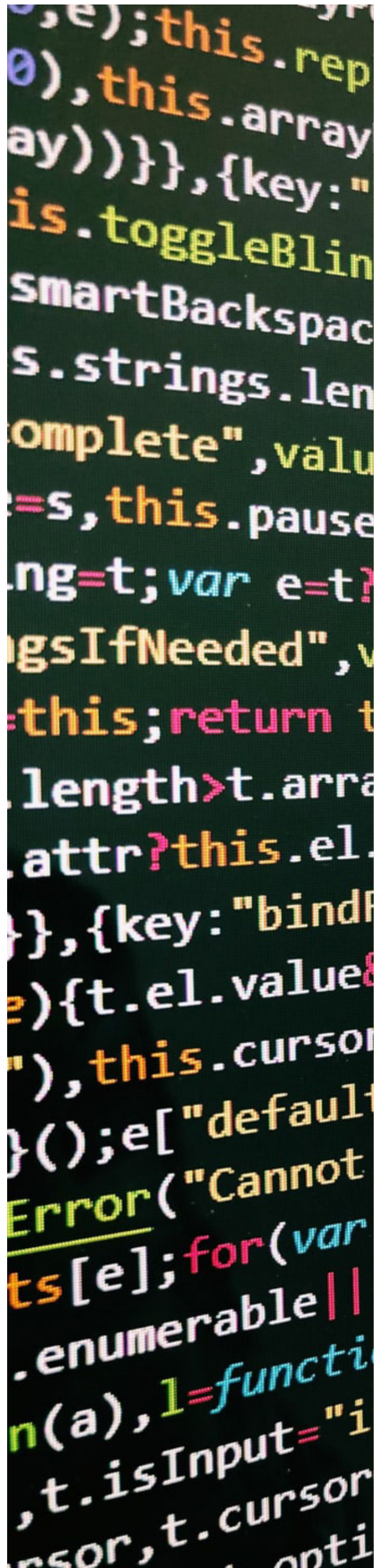
K-6 Computer Science Digital Tools

1. SCRATCH | FREE | https://scratch.mit.edu

Scratch helps students think creatively, reason systematically, and work collaboratively through block coding. Students can create and program interactive stories, games, and animations.

2. SCRATCHJR | FREE | www.scratchjr.org

With ScratchJr, young students program their own interactive stories and games. In the process, they learn to solve problems, design projects, and express themselves creatively.

3. CODESPARK | FREE | https://codespark.com

CodeSpark's word-free interface makes learning to code accessible to pre-readers and non-English speakers. It is free for use in public schools, libraries, and non-profits.

4. CODE.ORG | FREE | www.code.org

Code.org is a nonprofit dedicated to expanding computer science in schools and increasing population by women and underrepresented minorities.

5. KHAN ACADEMY | FREE | www.khanacademy.org

Khan Academy offers practice exercises, instructional videos, and a personalized learning dashboard that empower learners to learn at their own pace in and out of the classroom.

Supplemental STEM: Digital Tools

VEX Robotics

VEX Tournament Manager: Free
The VEX Tournament Manager is a custom software package designed to simplify and automate many of the tasks associated with running a VEX Robotics tournament. The program is flexible and modular and designed to work for small, local tournaments as well as large, international competitions and everything in between. https://vextm.dwabtech.com/

VEX IQ Code Blocks: Free
We all know that robots attract kids to learn. VEX Robotics and VEXcode are providing opportunities for students of all ages to participate in learning the code that makes these robots work. As students progress from elementary, middle, and high school, they never have to learn a different blocks, code, or toolbar interface. https://www.vexrobotics.com/vexcode

STEM Prep Specialists

Minecraft: Free for DSD Teachers.
Education Edition is an open-world game that promotes creativity, collaboration, and problem-solving in an immersive environment where the only limit is your imagination.https://education.minecraft.net/get-started/download/

Microsoft Teams: Free for DSD Teachers
STEM Prep Specialists can collaborate, meet, share ideas, and learn together on our Teams page. Find lesson plans, ask questions, and stay up to date on trainings and activities.

MESA Clubs

Engineering is Elementary: Free for DSD Teachers
A curriculum created especially for students in after-school programs! Follow India and Jacob as they solve real-life problems by using the engineering design process. Check out free kits to conduct engineering projects. Follow the link below to access teacher resources, additional activities, and more. https://www.eie.org/engineering-adventures

CONTACT INFORMATION

Tyson Grover
STEM Section Director
tgrover@dsdmail.net
801-864-8604

MaryEllen Marx
K-6 Computer Science Supervisor
mcarlson@dsdmail.net
801-402-5790

Lindsey Henderson
K-12 Math Supervisor
lhenderson@dsdmail.net
801-402-5288

Julie Sargent
Adminstrative Assistant
jsargent@dsdmail.net
801-402-5128

Annette Fonnesbeck
K-6 Science Specialist
afonnesbeck@dsdmail.net
801-402-5145

Margo Hammond
Adminstrative Assistant
mhammod@dsdmail.net
801-402-5251

Alexa Jensen
STEM Analyst/Coordinator
alejensen@dsdmail.net
801-402-5162