K-12 Science Curriculum Review

West St. Paul - Mendota Heights - Eagan Area Schools
School District 197

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Background

The current standards in place in Minnesota in the area of Science were adopted in 2009. The 2009 Minnesota Academic Standards in Science set the expectations for achievement in science for K-12 students in Minnesota. These standards:

- are grounded in the belief that all students can and should be scientifically literate.
- describe a connected body of science and engineering knowledge acquired through active participation in science experiences.
- are placed at the grade level where mastery is expected with recognition that a progression of learning experiences in earlier grades builds the foundation for mastery later on.

The Minnesota Academic Standards in Science are organized by grade level into four content strands:

- The Nature of Science and Engineering (which is embedded in the content in the other strands)
- Physical Science
- Earth and Space Science
- Life Science. It is

Each strand has three or four sub-strands. Each sub-strand contains two or more standards and one or more benchmarks. The benchmarks supplement the standards by specifying the academic knowledge and skills that schools must offer and students must achieve to satisfactorily complete a standard. Not all standards are found at every grade level.

State Science Standards Review

The 2019 Minnesota K-12 Academic Standards in Science (Standards) set the expectations for achievement in science for grades K-12 students in Minnesota. The Standards are grounded in the belief that all students can and should be scientifically literate. Scientific literacy enables people to use scientific principles and processes to make personal decisions and to participate in discussions of scientific issues that affect society (NRC, 1996). Graduates should be prepared for career and college opportunities.

The Standards describe a connected body of science and engineering knowledge acquired through active participation in science experiences. These experiences include hands-on laboratory activities rooted in science and engineering practices. The Standards are based on current science education found in A Framework for K-12 Science Education (Framework) (NRC, 2012), which emphasize the inclusion within science standards, curriculum, and instruction of three dimensions: Scientific and Engineering Practices, Crosscutting Concepts, and Disciplinary Core Ideas. The Framework is available as a free download at www.nap.edu.

The Standards have been submitted for the rulemaking process. The date by which all schools must implement the new standards will be determined during the rulemaking process. The commissioner is recommending that the year of full implementation be 2023-24. This is the year that the Minnesota Comprehensive Assessment (MCA-IV) would begin to assess the new standards.

Once approved, the 2019 K-12 Minnesota Science Standards will consist of four Disciplinary Core Ideas: Physical Science, Life Science, and Earth and Space Science. Engineering, Technology and the Applications of Science will be embedded throughout the benchmarks in the other three disciplines. Each grade level benchmark will include the Science and Engineering Practices and Crosscutting Concepts from the K-12 Framework for Science Education.

Three Dimensions from A Framework for K-12 Science Education

Science and Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas
This dimension focuses on the important practices used by scientists and engineers, which all students should learn to use with increasing sophistication over their years in school.	This dimension lists key concepts, or themes, which connect knowledge from the various disciplines of science and engineering into a coherent scientific view of the world.	This dimension includes the core ideas from the physical sciences, life sciences and earth and space sciences. Engineering, technology, and applications of science are included to provide an understanding of the built world.
1. Asking questions (for science) and defining problems (for engineering) 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations (for science) and designing solutions (for engineering) 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	1. Patterns 2. Cause and effect: mechanism and explanation 3. Scale, proportion, and quantity 4. Systems and system models 5. Energy and matter: flows, cycles, and conservation 6. Structure and function 7. Stability and change	**Physical Sciences** PS 1: Matter and its interactions PS 2: Motion and stability: Forces and interactions PS 3: Energy PS 4: Waves and their applications in technologies for information transfer **Life Sciences** LS 1: From molecules to organisms: Structures and processes LS 2: Ecosystems: Interactions, energy, and dynamics LS 3: Heredity: Inheritance and variation of traits LS 4: Biological Evolution: Unity and diversity **Earth and Space Sciences** ESS 1: Earth's place in the universe ESS 2: Earth's systems ESS 3: Earth and human activity **Engineering, Technology, and the Applications of Science** ETS 1: Engineering design ETS 2: Links among Engineering, Technology, Science and Society

Below is an example of how the three dimensions are included in a third grade Life Science benchmark:

3L.3.1.1.2 Develop multiple models to describe how organisms have unique and diverse life cycles but all have birth, growth, reproduction, and death in common. (P:2, CC:4, CI:LS1)

Disciplinary Core Idea: Life Science (CI:LS1)
Crosscutting Concept: Systems and system models (CC:4)
Science and Engineering Practice: Developing and using models (P:2)

This new vision for science education in the state of Minnesota implies many shifts in how instruction will be provided. The table below highlights some of these changes.

Less of...	More of..
Rote memorization of facts and terms	Facts and terms learned as needed while developing explanations and designing solutions using evidence
Learning ideas disconnected from questions about phenomena	System thinking and modeling to explain phenomena
Teacher providing information to the whole class	Students conducting investigations, solving problems and engaging in discussions
Teachers posing questions with one right answer	Students discussion open-ended questions
Students reading textbooks to answer questions	Students gathering information from multiple sources
Cookbook labs or hands-on activities	Multiple investigations driven by student questions
Worksheets	Students writing journals, report and media presentation to explain and argue
Oversimplification for students perceived as less able	Provision of support for sophisticated science for all

Current Practice

State requirements: All students in School District 197 receive instruction in Science. Science is one of our four core content areas along with Mathematics, English Language Arts and Social Studies. The current graduation requirements for science include three credits of science, two of which must be in Biology and Chemistry or Physics. There is current proposed legislation that aims to add a third required area in high school, Earth and Space Science.

In Kindergarten through fourth grade students use hands-on science units from various publishers including National Geographic, LEGO Engineering, Full Option Science System (FOSS), InSciEd Out and Dodge Nature Center. Each grade level has units that aligned to the 2009 science standards. In the 2019 version of the standards we see some minor shifts in content in the elementary grades. The major shift is how we address the content. Phenomena based instruction is called on to provide students with real life application of the concepts we are teaching. There is also a focus on how these concepts all link to the conservation of natural resources and their effects on the environment.

In grades 5-12, students continue to learn science concepts through a variety of approaches, including hands-on science activities, print and digital resources, as well as immersive opportunities such as InSciEd Out units and field trips to Dodge Nature Center. Each course has units that aligned to the 2009 science standards. In the 2019 version of the standards we see some significant shifts in content at the secondary level, specifically for grades 5, 6, and 8 as well as a shift towards a new course at the high school level. Just as in the elementary, a major shift will be how we address the content. Phenomena based instruction is called on to provide students with real life application of the concepts we are teaching. There is also a focus on how these concepts all link to the conservation of natural resources and their effects on our environment.

Middle School Requirements: All students complete four courses in science encompassing the middle school academic standards. There are two notable differences in how the courses will be situated to align with the state level science revision process. Those are noted below **in bold.**

Current Course Sequence

- Grade 5: Science 5
- Grade 6: Physical Science
- Grade 7: Life Science
- Grade 8: Earth and Space Science

Future Course Sequence

- Grade 5: Science 5
- **Grade 6: Earth and Space Science**
- Grade 7: Life Science
- **Grade 8: Physical Science**

A rationale from the Department of Education for the changes in middle school course sequence is provided below:

- Providing physical science at 8th grade aligns with algebra oriented 8th grade mathematics standards.
- This sequence provides smoother learning progressions in core ideas from elementary through middle to high school.
- This sequence recognizes the lack of laboratory equipment, facilities, and safety equipment for chemical and physics experimentation in many 6th grade classrooms.

High School Requirements: Currently, all students are required to satisfactorily complete three credits in Science which must include Biology and either Chemistry or Physics. At Henry Sibley students must complete the sequence described below.

- Grade 9: Completing either Physical Science 9 or Pre-AP Science 9
- Grade 10: Completing Biology or Advanced Placement (AP) Biology
- Grade 11: Completing Essential Chemistry or Chemistry

It is important to note that ESL learners with an english proficiency score between 1 and 3, participate in Sheltered Science classes for two years. Sheltered classes are taught by both a science teacher and an ESL teacher. Additionally, some special education students participate in Life Skills Science classes, based on their Individualized Education Plan (IEP). ESL and special education staff actively participate in all aspects of curriculum review.

Current legislation at the state level is proposing something similar to these requirements, with one possibly significant change, which is noted in **bold** below.

- Grade 10: Completing Biology or Advanced Placement (AP) Biology
- Grade 11: Completing Essential Chemistry, Chemistry or Physics
- **Grade TBD: Completing an Earth and Space Science Course**

While creating the new standards and requirements for science, the state level science review team advocated for strong high school Earth and Space Standards and the desire to provide for high school Earth science instruction. By moving many of the physical science core ideas from high school to eighth grade, students are prepared to take full high school level courses in chemistry and/or physics, life science, as well as making space for an Earth and space science.

This proposal to require students to complete an Earth and Space Science course impacts many facets of 197 science programming, including;

- what students will be learning (currently there isn't an Earth and Space science course at the high school)
- the scope and sequence at the high school level overall (where would the course fall in the sequence)
- elimination of a current ninth grade course (standards have moved to grade 8) Teacher Licensure challenges as very few staff have the necessary license to teach Earth and space science at the high school level)

Administration and the review team will monitor these developments in legislation and graduation requirements throughout the review process and develop options for how to address this if the proposal is approved.

The table below provides a high level overview of what content and standards are addressed in the current units of study and a glimpse into what the content and focus may be for future units of study based on the 2019 science standards changes. **NOTE: These are provided only as context to understanding the changes, and are likely to be modified as the team continues their work.**

Grade	Current Units of Study	2019 Science Standards
Grade K	• Trees • Weather • Sun • Plants and Animals	• Characteristics of/Patterns in Nature • Weather • Sun • Plants and Animals
Grade 1	• Soil and Rocks • LEGO Engineering • Animals	• Earth Processes (Erosion/Storms) • Plants and Animals • Sound
Grade 2	• Weather • Balance and Motion • States of Matter • Plants and Butterflies (Life cycle)	• Weather/Climate • Forces of Motion • Heating and Cooling of objects • Seed Dispersal and Habitat
Grade 3	• Sun, Moon and Stars • Light and Sound • Structure and Function of Animals	• Sun, Moon and Stars • Light • Life Cycle (Plants and Animals)
Grade 4	• Water • Rocks and Minerals • Electricity and Magnetism	• Water • Rocks and Landforms • Electricity and Magnetism • Inherited Traits
Grade 5	• History and Nature of Science and Engineering (embedded in content below) • Motion • Earth structures and processes • Structure and function of living systems • Human interactions with Earth and living systems	• Physical Science: Matter and energy • Life Science: Organism and ecosystems • Earth and Space Science: Earth's place in the universe
Grade 6	**Physical Science** • History and Nature of Science and Engineering (embedded in content below) • Matter • Motion • Energy • Human interactions with physical systems	**Earth and Space Science** • Earth's place in the universe • Earth's systems • Earth and human activity
Grade 7	**Life Science** • History and Nature of Science and Engineering (embedded in content below) • Structure and function in living systems • Interdependence among living systems • Evolution in living systems • Human interactions with life systems	**Life Science** • Molecules and organisms • Ecosystems • Heredity • Biological evolution
Grade 8	**Earth and Space Science** • History and Nature of Science and Engineering (embedded in content below) • Earth structures and processes • Interdependence within the Earth system • The universe • Human interactions with Earth systems	**Physical Science** • Matter • Motion • Energy • Waves

Grade	Current Units of Study	2019 Science Standards
Grade 9	**Physical Science (graduation requirement)** Courses include Physical Science and Pre-AP Science ● History and Nature of Science and Engineering (embedded in content below) ● Properties and structure or matter ● Changes in matter ● Describing motion and forces ● Energy types and energy transformations	**To be determined: Possibly an Earth Science course** ● Earth's systems and processes ● Human impacts and sustainability in Earth systems ● Earth's place in the universe ● Weather and Climate
Grade 10	**Life Science (graduation requirement)** Courses include Biology and AP Biology ● History and Nature of Science and Engineering (embedded in content below) ● Levels of organization ● Cells ● Ecosystems, flow of energy and matter ● Reproduction ● Variation and biological evolution ● Health and disease	**Life Science (graduation requirement)** Courses could include Biology and AP Biology ● Heredity: Inheritance and variation of traits ● Organisms and molecular structure and processes ● Ecosystems: Interactions, Energy and Dynamics ● Evolution: Unity and diversity
Grade 11	**Chemistry or Physics (graduation requirement)** Courses include Chemistry, Essential Chemistry, Foundations in Physics, and Physics. Students must take one chemistry or physics course for graduation. Content for these courses are grounded in the physical science standards and applied through the lens of either Chemistry or Physics, and include an embedded study of the History and Nature of Science and Engineering.	**Chemistry or Physics (graduation requirement)** Courses could include Chemistry, Essential Chemistry, Foundations in Physics, and Physics. Students must take one chemistry or physics course for graduation. Content for these courses are grounded in the physical science standards and applied through the lens of either Chemistry or Physics.
Grade 12	There is no requirement to take a fourth year of science, however there are a number of courses available for students to take, which are noted below: ● Human Anatomy and Physiology ● AP Chemistry ● AP Biology ● AP Physics Mechanics C ● College in the Schools - Introductory College Physics ● College in the Schools - Physics by Inquiry ● Tri-District Health Careers and Medicine (CAPS)	There is no requirement to take a fourth year of science. As the team designs their scope and sequence, the courses already available (and listed to the left) may continue on, as well as investigating whether other courses may provide additional opportunities and benefits for students' science education.

Summary

A review team (Appendix A) was put together including a representative K-12 group of teachers, as well as building and district administrators to evaluate the science curriculum. As a part of the review process in year one, our entire K-12 committee: performed an environmental scan, developed Core Beliefs and Outcomes that Matter to All, surveyed students, staff and families, conducted a Strengths and Weaknesses Analysis, reviewed the proposed state changes for science requirements and standards, and reviewed a variety of achievement measures in science. A summary and applicable insights for each element listed above can be found in the following report.

Environmental Scan

In order to get a broad sense of what students' science experience looks like across the district, our curriculum review team conducted an environmental scan of science instruction. Review members worked in grade and/or course alike groups to identify responses for a variety of questions, including, but not limited to, the examples below, and captured them on posters that they then were able to share.

- How much time do we have dedicated to science instruction at each grade and site?
- What does instruction during this time look like (whole group, small group, independent practice, etc.)
- What are the expected instructional practices or strategies used in science?
- What instructional materials do we utilize to teach science?

The product of these discussions were very helpful as a lead-in activity when the team started to identify our strengths and weaknesses for science instruction.

Core Beliefs and Outcomes that Matter to All

Science education in School District 197 should be grounded in the most current research available for how children and young adults learn and the implications for science instruction for students in grades K-12. "A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas" presents a conceptual framework through a compilation of the leading research in science education. This conceptual framework outlines six guiding principles which are drawn from what is known about the nature of learning science. School District 197 has formally adopted these six guiding principles as the K-12 Science Core Beliefs, which can be found in Appendix B of this report.

The team also developed our Outcomes that Matter to All. These outcomes provide a picture of what we want for all students in relationship to science education in School District 197. These outcomes can be found in Appendix C of this report and reinforce the desire to have students who are real-life problem solvers, who have the perseverance to work through challenging situations and are prepared for any college or career opportunity they desire when they leave our school district.

Strengths and Weaknesses

The curriculum review team dedicated time in each of their four meetings across the year to discuss what they believed to be the strengths and weaknesses of science education in School District 197. As the team completed the various tasks associated with curriculum review, items were added or modified to reflect the team's most current findings. In general, the strengths and weaknesses eventually fell into one of several categories, which are noted below:

- Cultural Inclusivity
- Instruction and Instructional Time
- Instructional Materials
- Scope and Sequence
- Home/School Connections

Overall, the team identified that School District 197 has a lot to be proud of in terms of science achievement and programming as well as several areas of opportunity. While School District 197 significantly outperforms students statewide as well as 197's comparable school districts (at each tested grade) annually on the MCA Science test (given at grades 5, 8 and after Biology in high school), the review team noted very wide racial, socio-economic, ability and English language-based disparities in student performance. Reducing these achievement disparities was an ongoing and pervasive discussion throughout all the curriculum review team's work.

The need for updated, culturally relevant and rigorous instructional materials which align with the state's expectations for phenomena-based instruction was a need expressed by the entire team at each of our meetings. As well as curriculum and instruction alignment, whether it be across all the grade levels at the elementary, at a course level, or between schools at the same level, was another often-expressed area for improvement.

The complete list of strengths and weaknesses can be found in Appendix D of this report.

Survey Data

Surveys were developed for teachers, students and families to complete in regards to science curriculum and instruction in our school district. The surveys were sent to families electronically and were made available on paper in English and Spanish in a variety of ways. Students in Grades 3 through 12 were asked to complete the survey during their science classes. Because of the strong efforts to expand ways that our team collected data, not only was the response rate for students and families higher than any previous curriculum review survey conducted in School District 197, it may have been the most diverse response rate as well, particularly for our families of English Language Learner students. In all, nearly 2000 students in grades 3-12 responded, as well as 477 families. The survey questions used can be found in Appendix E.

<u>Themes in the survey data indicate that:</u>

- Generally speaking, students at all levels find their science education enjoyable, and appreciate that they learn science through a variety of approaches (working in groups, kinesthetic activities, and hands-on experiences).
- In general, teachers were clear about the need for updated resources, including materials to match their students' needs, backgrounds, and interests. This finding confirms our previous findings from multiple elements within the review process.
- Overall, teachers identified the need and desire to work collaboratively with each other, both within a grade/course as well as across schools, to create consistency where needed, and to share and replicate innovative approaches where applicable. The curriculum review team noted that a focus on collaboration will be critical to their work as they implement the shifts in science education that are included in the changes within the MN science standards and requirements.
- Parents' comments focused primarily on one of three main topics.
    - First, families at the elementary level appreciate the science education that their children receive, and would like their children to have more opportunities to engage in science.
    - Second, families overall reported that they would appreciate more frequent communication about what their children are doing and learning about during these science experiences.
    - Third, families overall reported that the amount of homework that their children received in science was just about right, and that they felt equipped to help their children at home when needed in science.

Data Analysis

The curriculum team reviewed several types of data to help identify patterns in achievement, high school course enrollment, and post-secondary participation. The data can be found in Appendix F. Specifically, the team reviewed these areas:

- Achievement Measures
    - MCA-III Science by grade (Gr. 5, 8 and after Biology in high school), school, and student group categories
    - MCA-III Science in comparison to the list of comparable districts (overall, by grade, by student groups)
    - MCA-III Science benchmark analysis which indicates how well students do in specific MCA standards
    - Student grades in Gr. 5-12 science courses (by school, grade, course, and student group categories)
    - Analysis for associations between grades earned in science classes and MCA Science achievement
    - ACT Science by race and student group
- Post-Secondary Participation (Using MDE's Statewide Longitudinal Education Data System (SLEDS))
    - Participation patterns by institution (e.g. 2 or 4 year institutions, Public v. Private)
    - Most attended institutions by HSHS graduates
    - Participation in developmental coursework in post-secondary institutions
- Course enrollment in advanced science courses at Henry Sibley High School
    - Course by course analysis by student groups over time

<u>Themes from the data analysis review are noted below:</u>

- As a whole, students in District 197 not only annually outperform the state and all comparable schools on the MCA Science test, they significantly outperform them.
- While reviewing individual student groups (race, English language acquisition, students with an IEP), the review team noted that ISD197 consistently (and at times significantly) outperforms the state and comparable schools on the MCA Science tests on most if not all of these student groups. However, the disparities for students within isd197 for these student groups is consistently large as well (eg., white students outperforming black students by 42% in 2019).
- While there has been a slight drop in performance for all students on the MCA Science test for students in ISD197 over the last five years (<3% drop), the drop in performance has been identical at the state level.
- The difference in MCA Science achievement at the two middle schools has significantly narrowed over the course of the last five years, from nearly a 24% difference in 2015 to just under a 5% difference in 2019.
- The association between the grades that students earn in science and their performance on MCA grows stronger across the three years of MCA science testing.
- College credit bearing opportunities, such as Advanced Placement (AP) and College in the Schools (CIS) courses are not an accurate representation of the district's student population. Students of color, students who are acquiring English as a second language, students with IEPs, and students who qualify for free or reduced priced lunch are all underrepresented in participation in these higher level science courses.
- Course prerequisites for higher level science courses may be prohibiting some students from enrolling in them, such as the 9th grade Pre-AP Science course, which has specific math course prerequisites that not all our students are able to complete before 9th grade.

While there are many great things for ISD197 to be proud of in terms of science education, the team notes that in each and every measure reviewed, there are very wide disparities between our student groups. Eliminating these disparities will be a central focus for the review team in all the work that they do within this curriculum review process.

Educational Equity Analysis / Four Way Equity Test

Throughout the entire curriculum review process, the team was charged with routinely asking how the questions included in the Four Way Equity Test could be used to address findings from each particular stage in the review process. Examples for how this work was integrated throughout the process are noted below.

For reference, the Four- Way Equity Test questions are provided below as well:

1. Does this help to provide opportunities for students who have historically been underserved, underrepresented, or disadvantaged by the current system?
2. Does this help to ensure equitable access for all?
3. Does this help to eliminate barriers based on gender, race/ethnicity, national origin, color, disability, age or other protected group?
4. Does this ensure the same rigorous standards for academic performance exist for all students?

Environmental Scan and Strengths and Weaknesses

- Incorporating culturally inclusive pedagogy and resources in Science curriculum
- Including more students' voice and choice within the curriculum and literature
- Creating a more consistent Science program between all elementary and middle schools

Soliciting Input from Stakeholders (surveys)

- In general, teachers were clear about the need for updated resources, including materials to match their students' needs, backgrounds, and interests. This finding confirms our previous findings from multiple elements within the review process.

Data Analysis

- While there are many great things for ISD197 to be proud of in terms of science education, the team notes that in each and every measure reviewed there are very wide disparities between our student groups. Eliminating these disparities will be a central focus for the review team in all the work that they do within this curriculum review process.

Secondary Course participation

- College credit bearing opportunities, such as Advanced Placement (AP) and College in the Schools (CIS) courses are not an accurate representation of the district's student population. Students of color, students who are acquiring English as a second language, students with IEPs, and students who qualify for free or reduced priced lunch are all underrepresented in participation in these higher level science courses.
- Course prerequisites for higher level science courses may be prohibiting some students from enrolling in them, such as the 9th grade Pre-AP Science course, which has specific math course prerequisites that not all our students are able to complete before 9th grade.

Next Steps

In year two of curriculum review we will:

- Unpack benchmarks into grade level learning targets.
- Identify and develop storylines to teach scientific phenomena.
- Explore and identify resources to support each grade level's storylines and content.
- Develop an implementation plan to ensure all students in grades 3, 5 and 10 are prepared for the Spring 2024 MCA-IV in Science.
- Develop a plan for all science staff to complete professional development on the teaching of science through Phenomenon Based Instruction
- Engage the review team in professional development on the teaching of science through Phenomenon Based Instruction.
- Continue to monitor changes in teacher licensure as it relates to secondary course requirements and explore strategies for ensuring compliance with licensing requirements
- Identify the scope and sequence for the high school.

Appendix A: Science Review Team

Team Member	Title	Site
Anne Bolsem	Kindergarten Teacher	Garlough Environmental Magnet
Kalin Farrell	Grade 1 Teacher	Moreland Arts and Health Sciences Magnet
Julia Poppitz	Grade 2 Teacher	Mendota Elementary
Ryan Schmitt	Grade 3 Teacher	Pilot Knob STEM Magnet
Megan Tulia	Grade 4 Teacher	Somerset Elementary
Michele Link-Valenstien	Instructional Coach	Moreland Arts and Health Sciences Magnet
Ellie Anderson	Special Education Teacher	Somerset Elementary
Steven Anderson	ESL Teacher	Pilot Knob STEM Magnet
Cathy King	Magnet Facilitator	Garlough Environmental Magnet
Erin Schmidt	Instructional Coach	Heritage E-STEM Middle School
Kristin Dirksen	Grade 5 Science Teacher	Heritage E-STEM Middle School
Crystal Mielke	Grade 6 Science Teacher	Friendly Hills Middle School
Dan Reed	Grade 7 Science Teacher	Friendly Hills Middle School
Brianna Havir	Grade 8 Science Teacher	Heritage E-STEM Middle School
Marcie LaPointe	Magnet Facilitator	Heritage E-STEM Middle School
Greg Schmidt	Science Teacher (9th Grade Science)	Henry Sibley High School
Jennifer Nippert	Science Teacher (Biology	Henry Sibley High School
Elizabeth Howatt	Science Teacher (Physics)	Henry Sibley High School
Marc Tobias	Science Teacher (Chemistry)	Henry Sibley High School
Laura Scott	Special Education Teacher	Henry Sibley High School
Daven Kokkila	ESL Teacher	Henry Sibley High School
Mark Quinn	Principal	Moreland Arts and Health Sciences Magnet
Chris Hiti	Principal	Friendly Hills Middle School
Ron Monson	Principal	Henry Sibley High School
Miles Lawson	Secondary Curriculum & Gifted & Talented Coordinator	School District 197
Kate Skappel	Elementary Curriculum Coordinator	School District 197
Cari Jo Drewitz	Director of Curriculum, Instruction and Assessment	School District 197

Appendix B: K-12 Science Education Arts Core Beliefs

Science education in School District 197 should be grounded in the most current research available for how children and young adults learn and the implications for science instruction for students in grades K-12. "A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas" presents a conceptual framework through a compilation of the leading research in science education. This conceptual framework outlines six guiding principles which are drawn from what is known about the nature of learning science. School District 197 has formally adopted these six guiding principles as the K-12 Science Core Beliefs, which are noted below.

- We believe **children are born investigators**.
- We believe **focusing on core ideas and practices** as outlined in the K-12 Framework for Science Education, fosters a deep understanding of science and engineering.
- We believe an understanding of **science and engineering requires both knowledge and practice, and develops over time.**
- We believe high-quality science education should **connect to and expand students' interests and experiences.**
- We believe in providing **high-quality, diverse opportunities for all students** to engage in significant science and engineering learning.

Appendix C: K-12 Science Education Outcomes That Matter to All

Students will be able to:

- graduate high school college-ready and/or career-ready.
- demonstrate and defend their understanding of science and engineering verbally, graphically, visually, mathematically, and in writing.
- persevere to effectively solve problems (design solutions) using various tools.
- ask questions and apply scientific models to show understanding of scientific phenomena.
- use logical reasoning, data, and critical thinking to guide decision-making.
- collaborate with others to apply scientific concepts/processes to understand scientific phenomena.
- identify variables, assess and analyze data to draw logical conclusions.
- see how science applies to their lives.
- use critical thinking and literacy skills to analyze and question scientific information.

Appendix D: Strengths and Weaknesses

Strengths	Weaknesses
Cultural Inclusivity ● Science in the middle grades is where all students are reached and serviced. ● Success for those who often struggle in other subject areas ● Exposure to science in the community (Careers for example) ● Based on the benchmark analyses we reviewed, all our students see themselves as scientists Instruction ● Passionate staff ● Inquiry based ● Real world opportunities ● Dodge partnerships ● Staff use a variety of instructional strategies, such as Personalized Learning Instructional Materials ● Big investment by teachers into creating materials, and the results on the MCA show that we are not only performing at a high level, but we have and continually do outperform all our comparable districts and the state of MN. ● Our surveys indicated that technology was a key element within our science instruction. Scope and Sequence ● Transition from general topics to subject specific Home/School Connections ● Families and students are very satisfied with the level of science education in our district. Content ● At the K-5 level, based on MCA data, students appear to have a fairly balanced knowledge base across all four strands.	Content ● Students are engaged in science but the content seems too rigorous at times or not applicable. ● Specific content (physical, life, Earth/space) are not always topics that are fun for students to learn about. ● At the middle level, all ability ranges and skills levels are heterogeneously integrated into science class. This is both good, and difficult to manage. ● Science literacy ● Math skills, such as, but limited to, using measuring tools, graphing, finding averages, using equations are not strong enough to support some science content. Scope and Sequence ● Current curriculum and scope/sequence isn't working as well as it could. ● There is a need to fill in gaps in student experiences leading up to and within Grades 5-8 Science. ● There has not been much if any time provided for teams to work on horizontal or vertical alignment. Instructional Materials ● A lot of teacher-created materials. In some cases, most of the content delivered is now teacher created. With all the benefits that come with teacher's creating materials, it comes at a significant cost in terms of time, effort, etc. ● At the elementary level, the concept of having to create materials for teaching science is something that does not bring the same potential institutional value, and would be a serious issue. ● Some concern about the changes in science standards could lead to a misbalance in book-based instruction which is not developmentally appropriate nor inspiring for students to learn about. ● Resources, such as a lack of leveled reading resources at all levels. ● Equipment updates necessary ● The replenishment process of kits at the elementary level could be improved. ● Current curriculum doesn't enhance courses nor provide good hands on learning. Instruction ● Need more support for science teachers dealing with varied abilities in class. More support needed for teachers in terms of staffing and resources. This could be in the form of co-teacher support in SPED or EL. ● Meeting the needs of our EL students, our students of color and our students with IEPs are areas that we could improve. ● There are differences in how instruction is provided and what students have for experiences in science at both middle schools but all the same standards are addressed. Instructional Time ● With competition of time for subject areas, science, at least at the elementary level, is among the first subject areas to be shortened to adjust for other competing subjects. ● Time to implement everything that is needed or required Home/School Connections ● Based on our surveys, families would like to have more communication from schools about what is going on in science at school. ● Families and students both would like more opportunities for science.

Appendix E: Survey Questions

The review committee drafted the following questions for our curriculum review survey. The questions are similar in nature to other areas of curriculum that have gone under review in the past.

Teacher Survey

1. What grade level(s) or course(s) do you teach?
2. Please estimate how many minutes, on average, your students have science class per week.
3. What types of experiences most engage your students in science?
4. On average, how much daily science homework do students typically have from your class?
5. What kinds of science homework do you give in your classroom?
6. In a typical week during your science class, how much time do you spend on the skill areas listed below?
7. Please indicate the level to which you agree with the following statements.
8. How often do you use technology in your classroom, specifically during science class?
9. In what ways do you use technology to teach science?
10. On a scale of 1 to 4, how comfortable are you with the current set of science standards at your grade level?
11. What do you feel are the strengths of the current science curriculum at your level? Please be sure to include all levels you teach in your response.
12. What do you feel are the strengths of the new science curriculum at your level? Please be sure to include all levels you teach in your response.
13. What do you feel are the weaknesses of the current science curriculum at your level? Please be sure to include all levels you teach in your response.
14. What do you feel are the weaknesses of the new science curriculum at your level? Please be sure to include all levels you teach in your response.
15. Do you feel you have adequate resources to meet the needs of all students? If not, what resources are needed for you to meet the needs of all students?
16. In looking ahead to implementing new science standards and curriculum in a few years, what do you need?
17. What professional development do you feel is needed in the area of science instruction?
18. Is there anything else you would like to share with the K-12 Science Curriculum Review committee to help them guide their work?
19. At our next curriculum review meeting, John Olson, the Science Specialist from MDE, and a colleague of his whoserved on the standards review committee, will be attending to provide additional information for our team to consider, as well as be available for any questions we might have related to the science standards change. Do you have any questions you would like us to make sure we ask of them while they are with us related to the changes in science standards? If yes, please include them below in the comment box.

Student Survey

1. What school do you attend?
2. What grade are you in currently?
3. What kind of science activities do you enjoy? Choose as many as you want.
4. With what type of science resources do you prefer to use while learning about science? Choose as many as you want.
5. On a scale of 1 to 4, how would you rate your confidence level in science?
    - Not confident at all. I often struggle to understand what we are learning during science class.
    - Somewhat confident. I sometimes have trouble understanding what we are learning in science class.
    - Confident. I usually understand most of what we are learning during science class.
    - Very confident. Understanding what we are learning during science class comes very easy to me.
6. How do you generally feel about your science class and/or what you are learning during science?

7. Please use the space below If you would like to share anything else with us about your science experience so far in our district.

Parent/Family Survey

1. Rate your current satisfaction with the following components of science instruction for your student.
    - Instructional Materials (textbooks, trade books, etc.)
    - Amount of homework
    - Content of homework
    - Information material for parents
2. Are you able to help your child with science at home?
3. Rate how comfortable you are helping your child with science at home.
4. What changes (if any) do you want to see in science instruction?

Appendix F: Data Analysis

In all, the team spent the equivalent of nearly one whole meeting (approximately 6-7 hours) reviewing a variety of data (achievement, participation and enrollment, grades, etc.). The data provided below does not represent the entire body of data that the team reviewed, but instead is a sampling of some of the most important data that drove the team's work throughout the review process.

MCA Performance

The tables below show how students in School District 197 performed on the 2019 MCA Science test in comparison to the state and the list of District 197's comparable districts.

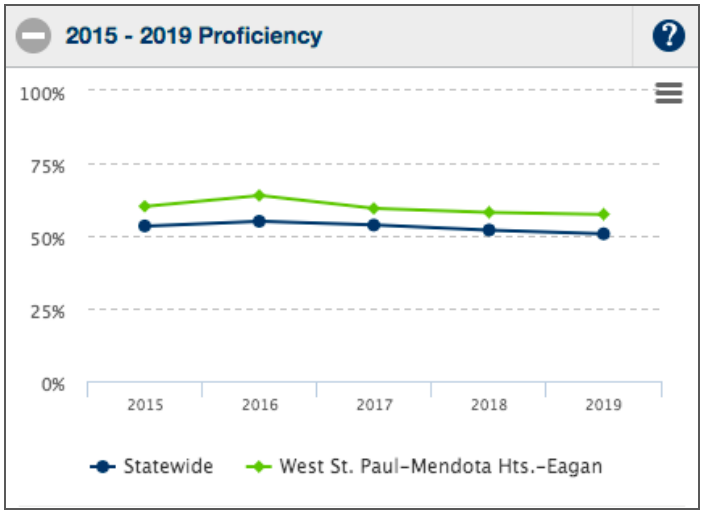
District	Science	FRP
WSP	**57.4%**	**41.2%**
Statewide	**50.7%**	**36.4%**
Hopkins	47.8%	35.4%
St. Louis Park	44.3%	36.1%
IGH	43.7%	40.1%
Osseo	40.9%	41.2%
Bloomington	40.5%	41.2%
Roseville	39.4%	44.7%
SLPark	38.1%	34.5%
SSP	36.7%	50.1%
Burnsville	36.4%	51.0%

District	Gr 5	Gr 8	HS	Science
WSP	**62.3%**	**44.0%**	**64.5%**	**57.4%**
Statewide	**54.9%**	**43.0%**	**54.4%**	**50.7%**
Hopkins	54.0%	38.8%	51.5%	47.8%
St. Louis Park	53.8%	35.2%	40.7%	44.3%
IGH	39.3%	35.1%	57.5%	43.7%
Differences*	8% to 13%	5% to 9%	7% to 14%	9% to 14%

District	Black	Hispanic	Asian	White	Male	Female	EL	SPED
WSP	**33.0%**	**36.0%**	**63.0%**	**75.0%**	**57.0%**	**58.0%**	**10.0%**	**26.0%**
Statewide	**22.0%**	**27.0%**	**45.0%**	**60.0%**	**52.0%**	**50.0%**	**7.0%**	**29.0%**
Hopkins	19.0%	26.0%	51.0%	63.0%	47.0%	49.0%	Cell Size	38.0%
St. Louis Park	17.0%	27.0%	Cell Size	62.0%	44.3%	44.3%	Cell Size	44.3%
IGH	18.0%	26.0%	43.0%	58.0%	45.0%	43.0%	Cell Size	21.0%
Avg. Difference	14.0%	9.5%	16.7%	14.3%	9.9%	11.4%	3.0%	-7.1%

The tables below show students' performance on the MCA in a variety of ways (by grade, school, student subgroup).

All students on MCA Science
(tested in grades 5, 8 and after completing Biology)



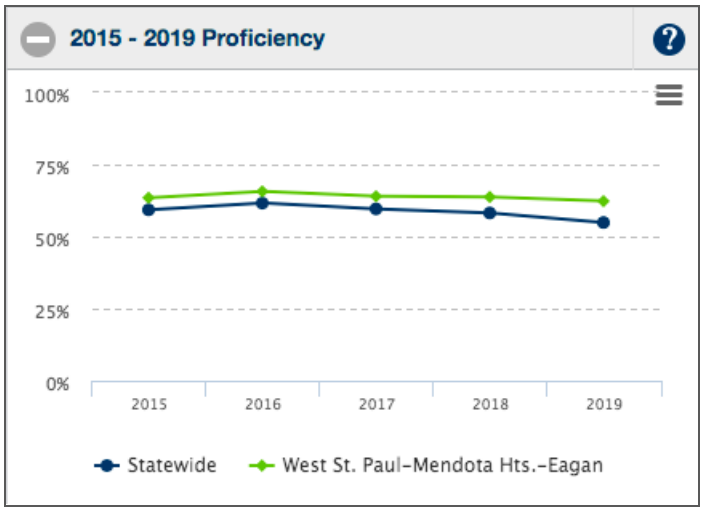
Statewide

Year	Percent proficient	Number proficient	Number tested
2015	53.4%	98,496	184,605
2016	55.0%	100,817	183,271
2017	53.7%	99,277	184,874
2018	52.0%	98,588	189,761
2019	50.7%	96,164	189,542

West St. Paul-Mendota Hts.-Eagan

Year	Percent proficient	Number proficient	Number tested
2015	60.2%	629	1,045
2016	63.9%	631	988
2017	59.4%	617	1,039
2018	58.1%	634	1,092
2019	57.4%	598	1,042

Grade 5 MCA Science



Statewide

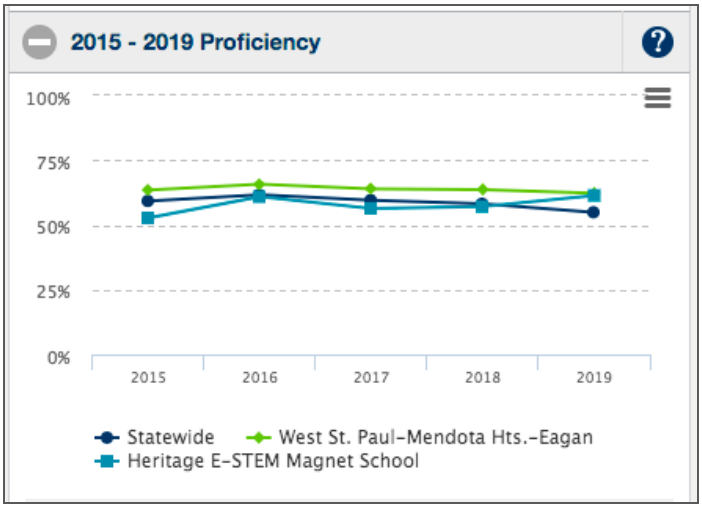
Year	Percent proficient	Number proficient	Number tested
2015	59.3%	37,855	63,838
2016	61.6%	39,243	63,731
2017	59.6%	38,495	64,548
2018	58.2%	38,806	66,641
2019	54.9%	36,530	66,542

West St. Paul-Mendota Hts.-Eagan

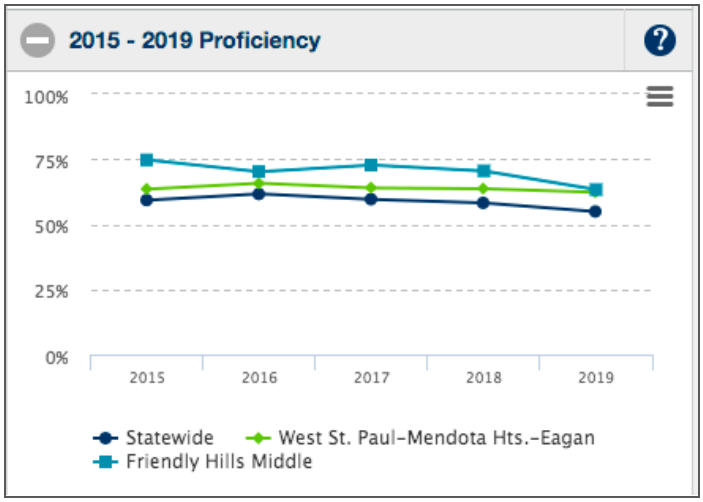
Year	Percent proficient	Number proficient	Number tested
2015	63.5%	251	395
2016	65.7%	218	332
2017	64.0%	226	353
2018	63.7%	246	386
2019	62.3%	251	403

Grade 5 MCA Science By School (Five year trend)

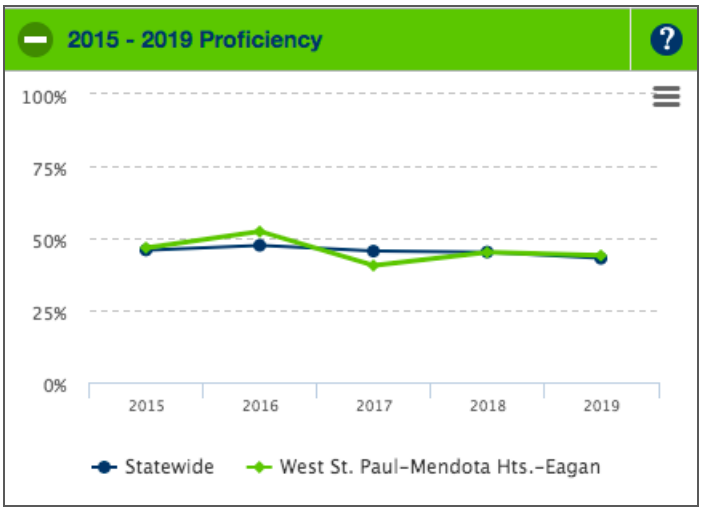
Heritage



Friendly Hills



Grade 8 MCA Science (five year trend)



Statewide

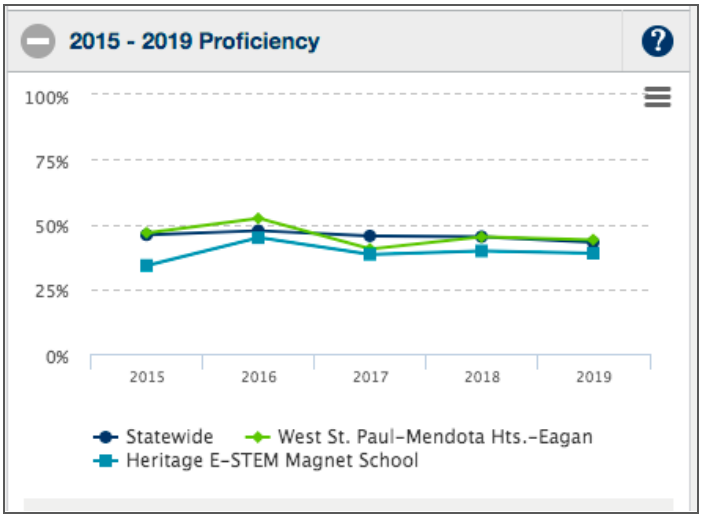
Year	Percent proficient	Number proficient	Number tested
2015	45.9%	28,639	62,453
2016	47.5%	29,193	61,464
2017	45.5%	28,291	62,127
2018	45.2%	29,055	64,271
2019	43.0%	27,424	63,741

West St. Paul-Mendota Hts.-Eagan

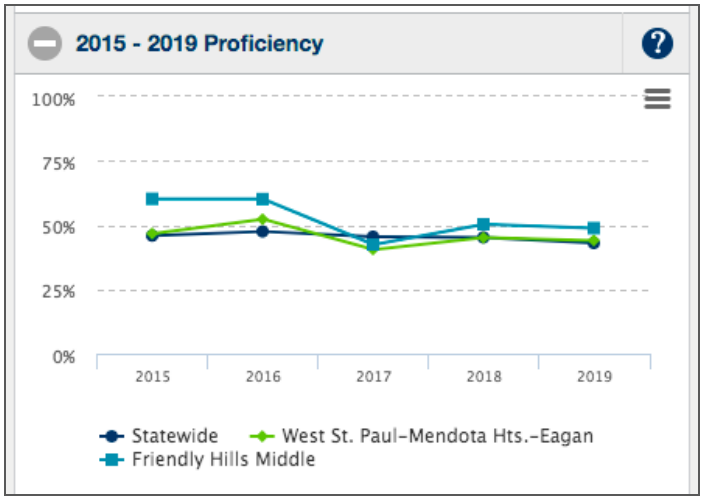
Year	Percent proficient	Number proficient	Number tested
2015	46.7%	161	345
2016	52.3%	179	342
2017	40.5%	136	336
2018	45.1%	166	368
2019	44.0%	140	318

Grade 5 MCA Science By School (Five year trend)

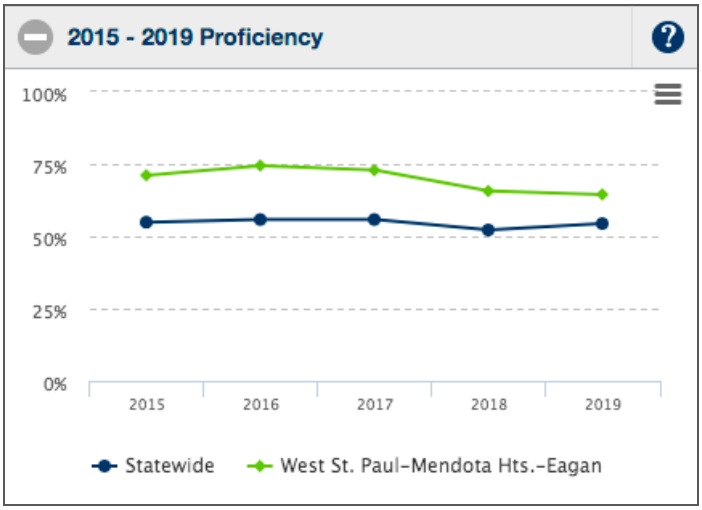
Heritage



Friendly Hills



Grade 8 MCA Science (five year trend)



Statewide

Year	Percent proficient	Number proficient	Number tested
2015	54.9%	32,002	58,314
2016	55.8%	32,381	58,076
2017	55.8%	32,491	58,199
2018	52.2%	30,727	58,849
2019	54.4%	32,210	59,259

West St. Paul-Mendota Hts.-Eagan

Year	Percent proficient	Number proficient	Number tested
2015	71.1%	217	305
2016	74.5%	234	314
2017	72.9%	255	350
2018	65.7%	222	338
2019	64.5%	207	321

Grades earned in science courses, by grade and/or site:

Failure rates by grade and by school in science classes (Failure rates in red below)

Add Student Filter
School of Instruction [Friendly Hills or Sibley or Heritage] x
Course Type [Science] x

2837 students in 9 groups

Early Warning Indicators HST Course Failures Student Failures in Science 2018-2019

	Current Grade ▲	
411	5	1% 99%
406	6	14% 86%
365	7	5% 95%
334	8	15% 85%
410	9	13% 87%
364	10	9% 91%
322	11	3% 97%
223	12	1% 99%

Add Student Filter
School of Instruction [Friendly Hills or Sibley or Heritage] x
Course Type [Science] x

2837 students in 3 groups

Early Warning Indicators HST Course Failures Student Failures in Science 2018-2019

	School of Enrollment ▲	
738	Friendly Hills	11% 89%
775	Heritage	6% 94%
1324	Sibley	7% 93%

Failure rates by race and English language acquisition in science classes by school (Failure rates in red below)

Add Student Filter
School of Instruction [Friendly Hills or Sibley or Heritage] x
Course Type [Science] x

2837 students in 7 groups

Early Warning Indicators HST Course Failures Student Failures in Science 2018-2019

	Ethnicity ▲	
304	African American	16% 84%
20	American Indian	10% 90%
114	Asian	4% 96%
1419	Caucasian	4% 96%
2	Hawaiian / PI	
804	Hispanic	12% 88%
174	Multi-Racial	9% 91%

Add Student Filter
School of Instruction [Friendly Hills or Sibley or Heritage] x
Course Type [Science] x

2837 students in 20 groups

Early Warning Indicators HST Course Failures Student Failures in Science 2018-2019

	Ethnicity ▲	School of Enrollment	
114	African American	Friendly Hills	18% 82%
64	African American	Heritage	11% 89%
126	African American	Sibley	17% 83%
4	American Indian	Friendly Hills	
7	American Indian	Heritage	14% 86%
9	American Indian	Sibley	11% 89%
32	Asian	Friendly Hills	
21	Asian	Heritage	14% 86%
61	Asian	Sibley	2% 98%
383	Caucasian	Friendly Hills	6% 94%
356	Caucasian	Heritage	3% 97%
680	Caucasian	Sibley	4% 96%
1	Hawaiian / PI	Friendly Hills	
1	Hawaiian / PI	Sibley	
145	Hispanic	Friendly Hills	19% 81%
268	Hispanic	Heritage	9% 91%
391	Hispanic	Sibley	11% 89%
59	Multi-Racial	Friendly Hills	15% 85%
59	Multi-Racial	Heritage	3% 97%
56	Multi-Racial	Sibley	7% 93%

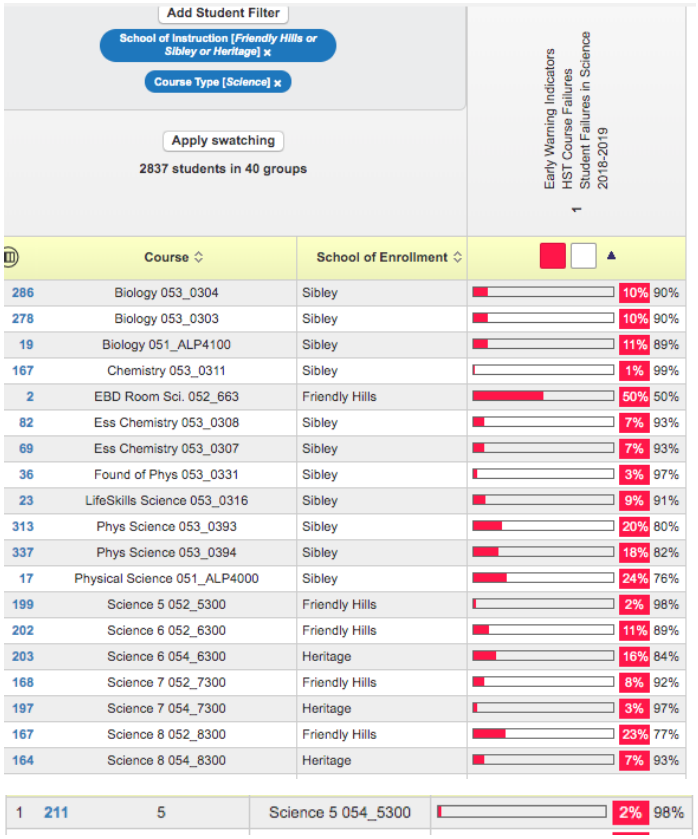
Add Student Filter
School of Instruction [Friendly Hills or Sibley or Heritage] x
Course Type [Science] x

Apply swatching
2837 students in 6 groups

Early Warning Indicators HST Course Failures Student Failures in Science 2018-2019

	School of Enrollment	LEP	
676	Friendly Hills	No	9% 91%
62	Friendly Hills	Yes	23% 77%
690	Heritage	No	6% 94%
85	Heritage	Yes	12% 88%
1208	Sibley	No	7% 93%
116	Sibley	Yes	13% 87%

Failure rates by course in Science classes (Failure rates in red below)

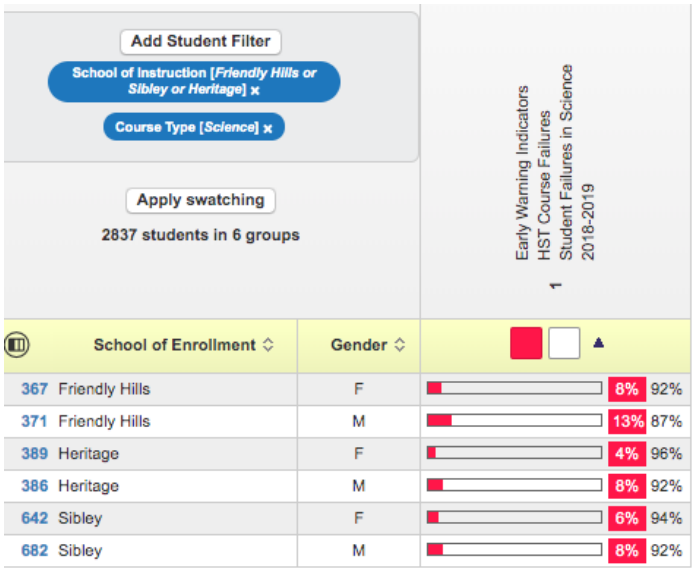


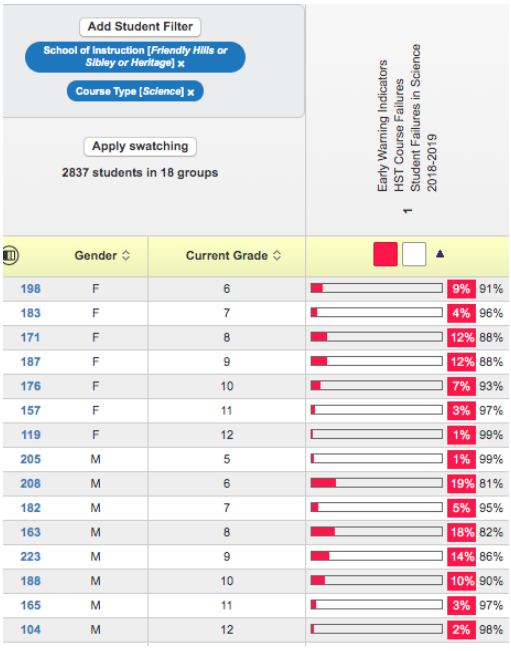
Failure rates by course and grade level taking the course

Failure Rates, by course, and grade (Sci.)

	Number	S1	S2			Number	S1	S2
Physical Sci 9	268, 291	20%	18%		Physical Sci 9	268, 291	20%	18%
PreAP Science 9	121, 114	0%	0%		Phy. Sci 9 (10)	37, 38	27%	24%
Biology 10	252, 258	8%	8%		Biology 10	252, 258	8%	8%
AP Biology 10	56, 53	0%	0%		Biology 10 (11)	22, 26	27%	23%

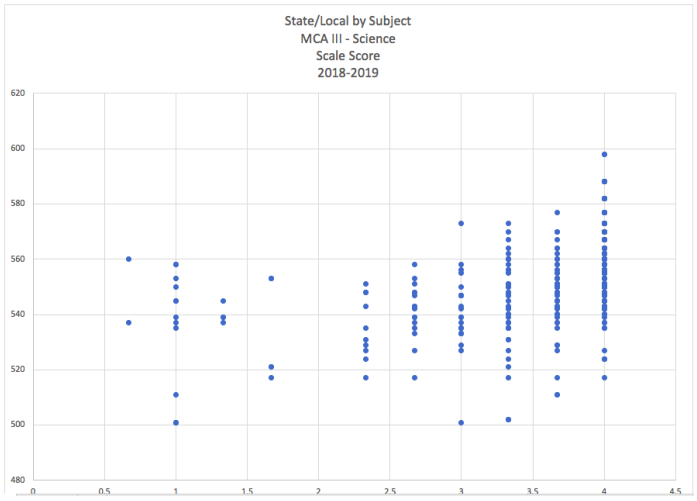
Failure rates by gender identification in Science classes by school and/or grade (Failure rates in red below)



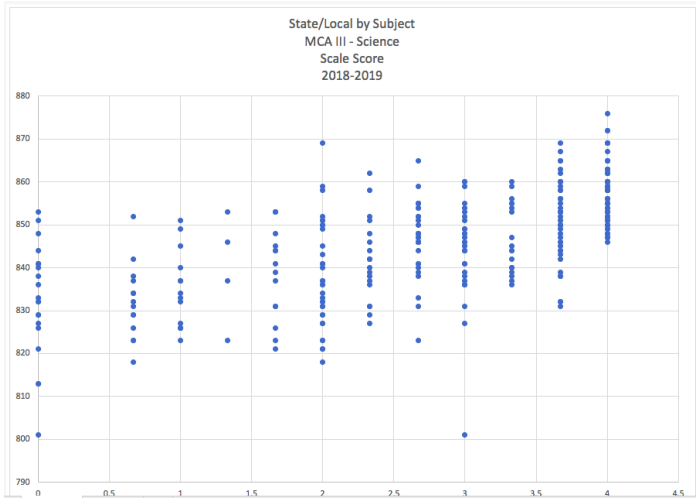


Grades earned in science courses and MCA Science performance comparison (MCA Scale Score versus Course Grade)

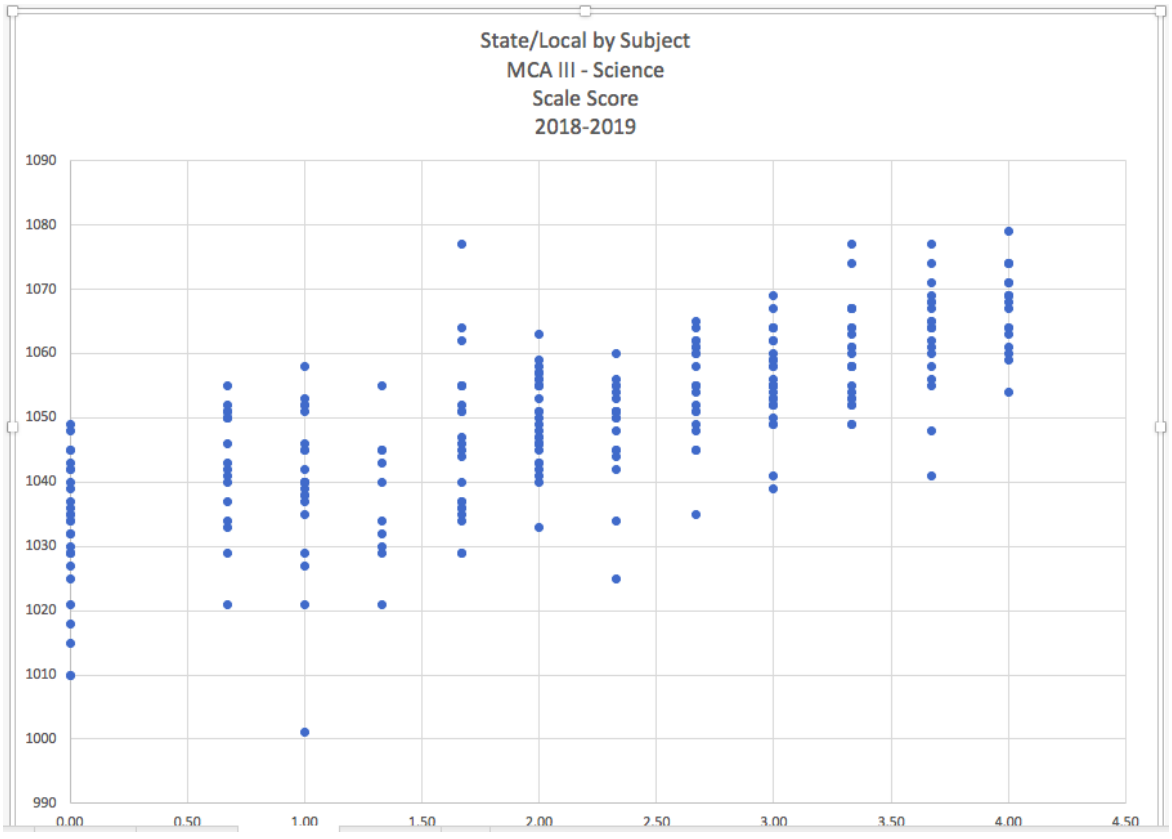
Grade 5



Grade 8



Grade 10



Course Enrollment Trends in Advanced Science Courses at High School
(Two years provided)

2017

2017	Pre-AP Sci	AP Biology	AP Chem	AP Phys-Mech	CIS Intro Physics	CIS Phy/Inq
African American	1%	2%	0%	0%	5%	8%
American Indian	0%	2%	0%	0%	0%	1%
Asian	3%	6%	9%	6%	12%	6%
Caucasian	79%	75%	86%	94%	63%	56%
Hispanic	14%	9%	5%	0%	12%	26%
IEP	2%	2%	0%	0%	0%	2%
EL	2%	2%	0%	0%	0%	1%
Female	53%	44%	53%	45%	42%	64%

2019

2019	Pre-AP Sci	AP Biology	AP Chem	AP Phys-Mech	CIS Intro Physics	CIS Phy/Inq
African American	4%	0%	6%	0%	6%	9%
American Indian	1%	0%	0%	0%	0%	0%
Asian	1%	3%	3%	10%	6%	12%
Caucasian	80%	85%	74%	76%	74%	52%
Hawaiian / PI	0%	0%	0%	0%	0%	0%
Hispanic	6%	7%	12%	10%	11%	20%
Multi-Racial	8%	5%	6%	5%	4%	7%
Female	62%	51%	53%	14%	49%	63%