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Science and Technology Education Program Evaluation Report 2022-2023

Introduction:

The Maine Learning Results in Science and Engineering was recently updated in 2019 with the goal of providing students with the knowledge and tools to understand and address many of the challenges of a rapidly-changing world, thus enabling them to be creative and practical problem solvers. The Maine Department of Education adopted the Next Generation Science Standards (NGSS) as the updated Maine Learning Results (MLR). The MLR (2019) document states “Science is a way of knowing about the world that enables people to both engage in the construction of new knowledge and to use the information to achieve desired ends.” It is important that as learners encounter diverse perspectives related to scientific issues they are integrative and informed thinkers (Maine Guiding Principle E) and able to discern reliable and valid information. The MLR supports such information as generated through accepted scientific and engineering practices. Additionally, science and engineering provide people with knowledge and tools to understand and address many of the challenges of a rapidly-changing world, thus enabling them to be creative and practical problem solvers (Maine Guiding Principle C).

The MLR supports students' studies in learning about and being able to critique the processes by which engineers develop and test products in response to consumer, industrial, and/or civic needs. The Maine Science and Engineering Standards provide a framework for supporting K-12 students' development as self-directed lifelong learners (Maine Guiding Principle B) who are able to apply knowledge from the domains of science and engineering to set goals and make decisions.

Additionally, the updates to the MLR have added standards to support students in becoming critical and engaged consumers of Science and Engineering. Engineering enables people to systematically solve problems using scientific knowledge, design, and test solutions, and evaluate them using agreed-upon and measurable criteria (MLR, 2019).

The Maine Learning Results provides the below outline of science, technology, and engineering strands and standards

Physical Sciences

- PS1 Matter and Its Interactions
- PS2 Motion and Stability: Forces and Interactions
- PS3 Energy
- PS4 Waves and Their Applications in Technologies

Life Sciences

- LS1 From Molecules to Organisms: Structures and Processes
- LS2 Ecosystems: Interactions, Energy, and Dynamics
- LS3 Heredity: Inheritance and Variation of Traits
- LS4 Biological Evolution: Unity and Diversity

Earth and Space Sciences

- ESS1 Earth's Place in the Universe
- ESS2 Earth's Systems
- ESS3 Earth and Human Activity

Engineering, Technology, and Applications of Science

- ETS1 Engineering Design

The program review process, performed during the 2022-2023 school year, was designed to evaluate whether the current programming in MSAD No. 75 is meeting the updated MLRs and the needs of our students who are expected to meet science standards. This report will identify a variety of elements of the program in order to facilitate ongoing improvement. In general, this evaluation will:

1. Review current programming
2. Review K-12 curriculum alignment
3. Review Maine Learning Results grade-level standards
3. Acknowledge strengths and weaknesses of implementation
4. Perform a gap analysis between 1, 2 & 3 and suggest proposals to close the gap. Additionally, the report will highlight strengths so that we can continue to build on these areas and make suggestions to address any weaknesses in our science and engineering programming.

Program Overview:

Elementary Schools:

The K-5 elementary schools use curriculum resources provided by online resources, Mystery Science and Stemsopes online. Beginning in the 2017-2018 school year, Stemsopes was

purchased in three increments until all grade levels had access which was completed during the 2019-2020 school year. Beginning in the school year 2020-2021, MSAD No. 75 collaborated with the Cathance River Educational Alliance (CREA) to offer professional development in implementing units aligned to the Stemscope 5E model: Engage, Explore, Explain, Elaborate, and Evaluate. The units by grade level are listed below.

Grade	Trimester One	Trimester Two	Trimester Three
Kind	Plants and Animals	Push/Pull	Weather
1st	Patterns in the Sky	Animals CER	Sound
2nd	Earth	Matter	Habitats
3rd	Life Cycles	Forces	Weather
4th	Erosion	Energy	Adaptations
5th	Matter Cycles	Mixtures	Earth Systems

The K-5 units have been designed specifically to ensure guaranteed and consistent delivery across all five elementary schools. The 2021-2022 school year was the first year horizontally-aligned units were expected to be reported to parents via the report card. During that same school year student work samples were collected so that samples could be calibrated and scored. The purpose of calibration is to ensure that as individual teachers evaluate student work the score is consistent and in alignment with the scoring rubric. This increases the reliability of the assessment data and elevates the rigor of the standard. This work of calibrating is ongoing and requires dedicated time outside of the school day to complete

Middle School

Using the NGSS as a guide, 6th-8th grade standards are spread across the grade levels. These standards are aligned so they vertically align with the elementary units. Topics were placed at each grade level based on both NGSS recommendation, developmental readiness, as well as commonalities with other curricula.

Teachers have common pacing guides for each grade level. Science and Engineering practices are embedded in each grade level science class and are explicit in STEM exploratory. Different than the elementary schools that are able to rely on Stemscope resources, middle school teachers often individually have to collate resource materials.

Grade	Units
6th Grade	<ul style="list-style-type: none"> ● Solar System Earth-Sun-Moon ● Cells, Genetic ● Body Systems ● States of Matter ● Water Cycle
7th Grade	<ul style="list-style-type: none"> ● Population Data and Resources ● Relationships between diverse populations ● Biological Cycle of Matter and Energy ● Potential and Kinetic Energy ● Magnetic and Electrical Fields ● Investigating Objects in Motion ● Interaction and Conservation of Matter ● Particle and Thermal Energy
8th Grade	<ul style="list-style-type: none"> ● Weather ● The Factors of Climate Change ● Human Impact On The Environment ● Geological Time and Process ● Cycles of Earth Energy ● Changes to Organisms Over Time ● Natural Selection and Evolution.

High School

Classes and individual units have been designed around the NGSS, with an emphasis on Earth and Space Science (ESS): Life Science (LS); and Physical Sciences (PS) with engineering standards worked in where appropriate. These standards are implemented through the science practices outlined in the NGSS, and classes work to incorporate the cross-cutting concepts (CCC) as well.

Students are advised of the following when selecting science courses:

- * At least three (3) science credits are required to graduate.
- * Educational experiences are required in Science I, II, III, and IV (Physical Science, Biology, Chemistry, and Physics). To meet these requirements, a student must complete one of the following core curriculum sequences:

A. Four-course sequence (recommended in preparation for post-secondary education):

Grade/Course

- 9th Grade: Science I (Physical Science, Academic Physical Science, or Advanced Physical Science)
- 10th Grade: Science II (Biology, Academic Biology, or Advanced Biology)
- 11th Grade: Science III (Chemistry, Academic Chemistry, or Advanced Chemistry)
- 12th Grade: Science IV (Physics, Academic Physics, or Advanced Physics)

B. Three-course sequence (not recommended if likely to pursue post-secondary education):

Grade/Course

- 9 Science I (Physical Science)
- 10 Science II (Biology or Academic Biology)
- 11 or 12 Science III/IV Combined(Chemistry/Physics)

Section	Course
Science I	<ul style="list-style-type: none"> ● Physical Science ● Academic Physical Science ● Advanced Physical Science ● Advanced Physical Science Lab
Science II	<ul style="list-style-type: none"> ● Biology ● Academic Biology ● Advanced Biology ● Advanced Biology Lab
Science III	<ul style="list-style-type: none"> ● Chemistry ● Academic Chemistry ● Advanced Chemistry ● Advanced Chemistry Lab
Science IV	<ul style="list-style-type: none"> ● Physics ● Academic Physics ● Advanced Physics ● Advanced Physics Lab
Science III/IV Combined Course	<ul style="list-style-type: none"> ● Chemistry/Physics
Electives	<ul style="list-style-type: none"> ● Anatomy ● AP Biology ● AP Biology Lab ● AP Environmental Science ● AP Environmental Science Lab ● Human Anatomy and Physiology ● Marine Science

	<ul style="list-style-type: none"> ● Wildlife ● Stem/Pre Engineering <p>* Elective courses may be taken in addition to, though not in replacement of, those from the selected core curriculum sequence.</p>
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K-12 Engineering Standards Alignment:

At the elementary and middle school, levels, engineering standards are embedded into units but standards are not reported in Infinite Campus, except in the middle-level STEM courses where these standards are explicitly taught and reported to parents. The high school addresses engineering standards in all core science classes but are not specifically reported in Infinite Campus. The STEM elective that is offered focuses explicitly on the NGSS engineering standards.

Time for Science in Schedules:

Elementary: At most schools, the average time written into the school's master schedule allows for 45-60 minutes per week. This can vary as teachers generally teach one unit at a time and depending on the length of the unit, these times are adjusted to allow for the appropriate pacing of materials. At Woodside Elementary School, 4th and 5th grades have designated science blocks that equal 200 minutes per week.

Middle School: All grade levels have 240 minutes per week.

High School: 208 minutes per week (two 80-minute blocks, one 48-minute block)

Additional Support for Students

At the elementary and middle school level, accessibility during science often refers to reading support and/or writing scribes during science. Case managers always work to assign the best method of support, and any other modifications or accommodations are provided by classroom teachers. The high school offers special education science classes for biology and chemistry/physics classes. All students are offered after-school support at MTA.

Common Assessments by Grade Level or Course:

Common assessments provide teachers with the opportunity to clearly measure their teaching strategies and help teachers quickly identify where students are struggling. Common assessments are used to measure students' performance consistently and fairly, ensuring that all students have an equal chance of succeeding in critical subjects.

At the elementary school, there is one common assessment per trimester in each grade level (one per unit). The 2021-2022 school year was the first year all students were assessed with a common grade-level assessment, and more work is needed to review the student work samples that were collected to align with the rubric and assure we have the highest rigor embedded into each rubric.

The middle school schedules time each week to review unit lessons and common assessments but still aspires to have a more detailed assessment for each standard within the unit. The high school plans around common assessments in core classes for each strand (physical science, biology, chemistry, and physics).

State Data Assessment:

During the spring of 2021, the Maine Department of Education administered a science field test for Maine Science and MSAA science assessments. The field test allowed the Maine DOE to ensure the items obtained within the assessment functioned and provided the intended information. Due to this form of assessment, the scores are used to produce information about students' performance. Due to this change, the only available data is from the Spring of 2022. This is baseline data with no historical data available.

5th Grade Science Scores 2021-2022 Score Comparison																							
<table border="1"> <tr><td>School Average (BCS)</td><td>36.63</td></tr> <tr><td>District Average</td><td>35.23</td></tr> <tr><td>State Average</td><td>34.52</td></tr> </table>		School Average (BCS)	36.63	District Average	35.23	State Average	34.52	<table border="1"> <tr><td>School Average (BHM)</td><td>36.24</td></tr> <tr><td>District Average</td><td>35.23</td></tr> <tr><td>State Average</td><td>34.52</td></tr> </table>		School Average (BHM)	36.24	District Average	35.23	State Average	34.52	<table border="1"> <tr><td>School Average (HCS)</td><td>35.24</td></tr> <tr><td>District Average</td><td>35.23</td></tr> <tr><td>State Average</td><td>34.52</td></tr> </table>		School Average (HCS)	35.24	District Average	35.23	State Average	34.52
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<p>5th-grade test items and scenarios focus on the following sub-standards:</p>																							

- Structure and Properties of Matter
- Matter and Energy in Organisms and Ecosystems
- Earth Systems and Space Systems: Stars and the Solar Systems

**Grade 8 Science Scores 2021-2022
Score Comparisons**

School Average	38.78
District Average	38.72
State Average	38.91

- Above State Expectations (60-90)
- At State Expectations (40-59)
- Below State Expectations (34-39)
- Well Below State Expectations (0-33)

8th grade test items and scenarios focus on the following sub-standards:

- Physical Sciences
- Life Sciences
- Earth and Space Sciences
- Science Practices: Investigate, Evaluate, and Scientific Reasoning

**High School Science Scores 2021-2022
3rd Year High School
Score Comparisons**

School Average	34.63
District Average	34.63
State Average	36.47

- Above State Expectations (50-90)
- At State Expectations (40-49)
- Below State Expectations (35-39)
- Well Below State Expectations (0-34)

11th grade test items and scenarios focus on the following sub-standards:

- Physical Sciences
- Life Sciences
- Earth and Space Sciences

- Science Practices: Investigate, Evaluate, and Scientific Reasoning

As a team, we do want to note the data is following two abnormal school years caused by the pandemic. The only grade levels to take the science assessment are 5th, 8th, and 11th graders. The data from the new assessment is vastly different from trend data from previous years.

Coupled with the science assessment being new, it was also administered to a group of learners who missed quality education during the pandemic teaching years. Building administrators are committed to continuing to review data and support one of the Finding #1 within this review.

Professional Development

As noted earlier in the review, the elementary schools have been working closely with staff developers from the Cathance River Educational Alliance (CREA) for staff development during late-arrival Wednesdays. Staff from CREA have also made themselves available to teachers with individual questions or planning needs. Some teachers have been able to attend conferences offered by USM focused on Talk Science & Write Science. The middle school heavily relies on a consulting model where the science focus group leader meets with all science teachers bi-monthly, but these meetings usually focus on curriculum rather than instructional practices. Funding for high school teachers is available for outside professional development upon request.

Technology Integration With Science

Because Stemsopes provides student accounts at the elementary level, some upper-grade elementary students are using one-to-one devices to interact with content. All grade levels are using scientific tools such as temperature probes, microscopes, and lab materials.

All levels are also using the Promethean boards. High school science teachers of biology and physics classes use computer models, digital data collection, and probes to collect data. Remote data collection is also done in marine science and wildlife electives. With the new MLR having increased emphasis on technology and engineering, technology integration is an area of needed growth at all grade levels.

Extensions

At this time, MSAD No. 75 does not provide GT services for science at the elementary level. Mt. Ararat Middle School has recently added an exploratory pathway that focuses on STEM-related studies. Mt. Ararat High School offers a number of after-school experiences offered throughout the school year, including Envirothon, SeaPerch, and Science Bowl. The Community Pathways Program at Mt. Ararat is a new avenue for science-related professions to be explored. This is an opportunity to exponentially impact STEM-related college and career readiness.

Findings and Proposals

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- **Finding 1:** Due to the newly-adopted Maine Learning Results and the need for common assessments there are gaps in clearly defined rigor expected for each standard.
 - **Proposal 1A:** Create a K-12 science curriculum team to calibrate common assessments. This team's goals would include:
 - Review current learning goals that are written for K-12 horizontal and vertical alignment to ensure rigor at all levels
 - Collect and calibrate common assessments at the K-5 level
 - **Proposal 1B:** Request time in the elementary school's master schedule so there is consistent and sufficient time dedicated to science instruction.
- **Finding 2:** There is a need for updated curriculum resources at the middle school.
Proposal: Have the same curriculum team from Proposal 1A review resources used at the middle school and make any recommendations for resources needed to align the curriculum.

Conclusion;

The adoption of the Next Generation Science Standards for the Maine Learning Results is a welcomed change. Outside the needed alignment to the new MLR, this review offers an opportunity to leverage teaching and learning resources that support a cohesive, rigorous K–12 STEM approach to learning that is based on real-world applications with the processes of critical thinking and analysis integrating science, technology, engineering, and mathematics. Most recently Art has been added to this paradigm, and this is paired well with the current Visual and Performing Arts review that is being conducted during the 2023-2024 school year. A rigorous STEM curriculum will provide unique experiences for all of our students and prepare them for jobs and careers that are growing and emerging into jobs that are on the horizon.

Committee Members:

2022-2023 Science Program Evaluation Committee Members:

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