

FLORIDA STANDARDS ANALYSIS

THE “E” IN STEM

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INTRODUCTION

The state of Florida guides instruction in STEM areas with specific standards. These standards for math are called the Mathematics Florida Standards (MAFS), for science are called the Next Generation Sunshine State Standards (NGSS), and for technology, Florida recommends the ISTE Standards. With the increased emphasis on STEM education, Florida also looks to the Engineering Practices in the Next Generation Science Standards (NGSS). These standards, in various ways, relate to engineering design problem solving in the STEM classroom.

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The Mathematics Florida Standards (MAFS) focus on problem solving and engineering design as they relate to real-world problems, focusing primarily on data generation and data analysis and application of learned techniques. For example, in the standard MAFS.5.MD.2.2, students make line plots to display data sets of measurement using fractions, and then use the operations on fractions to solve problems. In the standard MAFS.5.OA.2.3, students generate numerical patterns using given rules, identify apparent relationships between terms, and graph the terms on a coordinate plane. Both of these standards give the students the tools of data generation and analysis to help them interpret information and use this information to solve problems. The MAFS also focus on applying understandings of concepts to make models and create new applications. For example, in the standard MAFS.5.MD.3.5.c, students find volumes of solid figures composed of two rectangular prisms by adding the volumes of the non-overlapping parts, and then applying this technique to solve real world problems.

The Next Generation Sunshine State Standards (NGSSS) focus on using the scientific method as a tool for investigating and explaining concepts, and for solving problems and making models to explore engineering design. For example, standards SC.5.N.1.1 and SC.5.N.2.1 state that students will define a problem, use appropriate reference materials to support scientific understand, plan and carry out scientific investigations of various types, and recognize and explain that science is grounded in empirical observations that are testable and must always be linked with evidence. In standard SC.5.P.8.2, students investigate and identify materials that will dissolve in water and those that will not and identify the conditions that will speed up or slow down the dissolving process, in standard SC.5.P.9.1, students investigate and describe physical and chemical changes affected by temperature, and in standard SC.5.P.13.4, students investigate and explain that when a force is applied to an object but it does not move, it is because another opposing force is being applied by something in the environment so that the forces are balanced. Through these standards, students are using problem solving and engineering design concepts to perform investigations.

The ISTE standards focus on using technology in problem solving and engineering design. In standard 1, students use technology to take an active role in the understanding of emerging technologies. They demonstrate the ability to choose, use and troubleshoot current technologies and are able to transfer their knowledge to explore emerging technologies. In standard 3, students build knowledge by actively exploring real-world issues and problems,

develop their own ideas and theories, and then pursue answers and solutions to these problems. In standard 4, students use technology to identify and solve problems. In standard 5, students collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making. In these standards, technology aids students in problems solving and engineering design. Finally, in standard 7, students explore local and global issues and use collaborative technologies to work with others to investigate solutions.

ENGINEERING DESIGN PROBLEM SOLVING

Even though the MAFS and NGSSS standards focus on specific, focused areas of content specific study, the skills learned through the application of these standards can be applied to work together in engineering design problem solving. Students use the NGSSS standards to define problems and carry out experiments to help them discover new things. The MAFS standards assist students in collecting, organizing, interpreting and analyzing the data they collect. The integration of the ISTE standards also allow students to use technology in each step of the design.

By incorporating engineering design problem solving into the instructional model, students are able to synthesize the concepts learned in isolated topics. They can use the math, science, engineering, and technology skills they have learned and apply them in new ways. This can help students gain a more global perspective on their learning. Engineering design problem solving allows students to demonstrate an understanding of math and science standards through the application of engineering practices.

PROBLEM SOLVING AND ENGINEERING DESIGN STANDARDS

MAFS	NGSSS	ISTE
<p>MAFS.5.OA.2.3-Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns, and graph the ordered pairs on a coordinate plane</p>	<p>SC.5.P.8.2-Investigate and identify materials that will dissolve in water and those that will not and identify the conditions that will speed up or slow down the dissolving process</p>	<p>1d-Students understand the fundamental concepts of technology operations, demonstrate the ability to choose, use and troubleshoot current technologies and are able to transfer their knowledge to explore emerging technologies.</p>
<p>MAFS.5.MD.2.2-Make a line plot to display a data set of measurements in fractions of a unit ($\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$). Use operations on fractions for this grade to solve problems involving information presented in line plots.</p>	<p>SC.5.P.9.1-Investigate and describe that many physical and chemical changes are affected by temperature</p>	<p>3c- Students curate information from digital resources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions.</p>
<p>MAFS.5.NF.2.4-b-Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction. b. Find the area of a rectangle with fractional side lengths by tiling it with unit squares of the appropriate unit fraction side lengths, and show that the area is the same as would be found by multiplying the side lengths.</p>	<p>SC.5.P.13.4-Investigate and explain that when a force is applied to an object but it does not move, it is because another opposing force is being applied by something in the environment so that the forces are balanced.</p>	<p>3d-Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.</p>

<p>MAFS.5.MD.3.5-c-Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume. c. Recognize volume as additive. Find volumes of solid figures composed of two non-overlapping right rectangular prisms by adding the volumes of the non-overlapping parts, applying this technique to solve real world problems.</p>	<p>SC.5.N.2.1-Recognize and explain that science is grounded in empirical observations that are testable; explanation must always be linked with evidence.</p>	<p>4a-Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.</p>
	<p>SC.5.N.1.1-Define a problem, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigations of various types such as: systematic observations, experiments requiring the identification of variables, collecting and organizing data, interpreting data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions</p>	<p>4b-Students select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.</p>
	<p>SC.5.P.10.2-Investigate and explain that energy has the ability to cause motion or create change.</p>	<p>4d-Students exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems.</p>
	<p>SC.5.P.10.4-Investigate and explain that electrical energy can be transformed into heat, light, and sound energy, as well as the energy of motion.</p>	<p>5a-Students formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.</p>

		<p>5b-Students collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.</p>
		<p>7b-Students use collaborative tech to work with others, including peers, experts or community members, to examine issues and problems from multiple viewpoints</p>
		<p>7d-Students explore local and global issues and use collaborative technologies to work with others to investigate solutions.</p>

REFERENCES

Florida Department of Education, Standards and Instructional Support. S. (n.d.). Standards & Instructional Support. Retrieved from <http://www.fldoe.org/academics/standards>

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