Medea Creek Middle School Implementation of Inquiry-Based Next Generation Science Standards

Description of the Model

Medea Creek Middle School (MCMS) has a laboratory-based Science program that is constructed to implement the California State Standards and the Next Generation Science Standards (NGSS). MCMS is an early implementer of the NGSS with our teachers working district-wide to create a successful progression and transition from middle school through high school. NGSS asks educators and students to approach teaching, learning, and monitoring student progress that creates a deep understanding of the different fields of scientific study along with the key techniques and procedures of laboratory science described in the Science Practices of NGSS. It is not a specific curriculum where students memorize facts and take multiple choice tests on content topics. NGSS is performanced based and requires students to demonstrate their understanding of the content through hands-on activities like model-making, engineering, experiment design, and implementation. This approach not only teaches the science standards, but builds critical thinking and communication skills for the students' future in our global society.

The Science program is aligned with the Oak Park Unified School District (OPUSD) goals and addresses essential areas related to Science instruction and NGSS implementation in its LCAP.

- Goal 1 (Action 2) calls upon schools to "Adopt/purchase textbooks and instructional materials for NGSS".
- Goal 1 (Action 3) "Continue to provide NGSS training to all staff and administrators."
- Goal 1 (Action 5) "Develop CTE pathway map for MCMS and OPHS" which includes instruction within the Science classes leading towards CTE offerings in the high school.
- Goal 2 (Action 12) addresses environmental education that is integrated into instruction and programs incorporated throughout the NGSS implementation.

At MCMS, the Science Department has chosen to implement NGSS using an inquiry-based approach. At the start of each unit, students are presented with an initial problem or phenomenon that they will have to "solve." Students then perform investigative labs to gather data, research the topic, and work together to gain a deeper understanding of the phenomenon. Students are never just given the answer, they must do the work and investigative science to derive the answers on their own. Of course, teachers are there to help correct misconceptions and to guide the direction of the learning, but we do try to have our classes be as student driven as possible.

Implementation and Monitoring of the Model

The journey to our implementation of an inquiry-based NGSS learning model started over six years ago, prior to the NGSS adoption, when our Science Department sought

dynamic ways to get students actively involved, truly excited about learning, all the while covering standards and meeting the needs of our diverse learning community. An inquiry-based learning model emerged as a way to achieve this goal.

Starting in 2012, a cohort of MCMS science teachers began a multi-year training with the Critical Thinking Institute (CTI) at UCLA, an intensive program on how to implement inquiry-based learning in the classroom. As we began to implement inquiry-based learning in our science classes at MCMS, delightful things started happening. We immediately noticed increased student participation and engagement at all levels and among all learners. Curiosity bloomed and students became excited to engage in critical thinking and problem solving activities. Seeing these results, the MCMS Science Department decided to adopt an inquiry-based model of instruction, which left us perfectly positioned to take on the upcoming change in science standards.

In 2013 when the state of California adopted NGSS, MCMS was already in the process of adopting the curriculum and strategies in the new standards. We started by drafting a multi-year plan to fully implement the integrated NGSS model in grades 6-8. This plan included a gradual shift from old to new standards and learning models. During the next few years teachers and administrators attended many trainings and spent untold hours collaborating to design, create, and implement inquiry-based NGSS curriculum materials. The MCMS Science Department and administrators participated in a wide range of professional development. The UCLA CTI served as the initial training program for inquiry-based learning. To better meet the needs of our MCMS teachers, we later developed, and now manage, our own inquiry-based learning program called the Oak Park Inquiry Institute (OPII). OPII offers professional development about inquiry-based learning models for K-12 teachers inside and outside of the Oak Park Unified School District. Several MCMS Science Department teachers currently serve as instructors and teacher mentors for OPII participants. In addition, Science Department teachers take four department planning days each year to provide dedicated time for working together to design, develop and implement new curricular materials. Professional development trainings and additional curriculum writing took place through stipended summer work. Further development opportunities came through such programs as NGSS Rollout sessions offered through the Ventura County Office of Education, the annual conference of the National Science Teachers Association, the annual conference of the California Science Teachers Association, and workshops from CSUN's Science Learning Collaboratory.

Full implementation of an inquiry-based NGSS curriculum came to fruition during the 2017-2018 academic year. Over time, it has become clear that NGSS inquiry-based science instruction perfectly meets the goals and philosophies of MCMS and OPUSD of students being actively involved and truly excited about learning Science. Our model meets the needs of our varied learners: kinesthetic, linguistic, visual, logical, social, and aural. Whether Medea students have skill deficits, social-emotional or behavioral challenges, and/or GATE needs, this hands-on, student-driven approach puts all students in the driver's seat of their learning. And because we start a unit with unknown

questions and big ideas, everyone is on the same level playing field, because no one has the answers...yet! Work is differentiated and/or scaffolded to meet students' varied needs. From understanding the basics, to digging deeper, students work together to gather data, research topics, build models, and engineer solutions. Reading, math, communication, critical thinking, and problem-solving skills are developed along the way. In addition to these tangible academic skills, students develop an increased ownership of the learning process that they can then apply to all of their other classes.

Some examples of the inquiry-style lessons include: In 7th grade, one performance expectation is to undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical means. Students are tasked with the mission of designing a device that keeps a reptile egg incubated and protected as it is transferred from a construction site to a rescue center. They must design and build a heat pack that will heat to a specific temperature range, but must discover on their own the ratio of the right chemicals to mix to reach that temperature. They are first given a variety of different chemicals to test, not all of which heat up. It is up to the students to discover, through iterative testing, the best ratio of various chemicals for a successful device. They also have to design and build the rest of the incubator that will protect the egg during transport. For another example, in 8th grade, the integrated model for NGSS includes many physics concepts centering around the driving question, "What happens when objects move and collide?" As part of covering these standards, students are asked to connect physics to the real world phenomena of car crashes and the science behind automobile safety design. Students are presented with the challenge of designing, building, and testing a small paper car capable of withstanding forces and protecting a raw egg during a simulated crash. Over the course of several weeks, students engage in research, lessons, and activities to cultivate the physics knowledge and skills they will need to engage in the design process. During the design process, students are given the time necessary to test and revise multiple iterations of their car in order to learn from failures along the way and arrive at a design that will (hopefully) successfully protect a raw egg, when sent down a 3 meter long race track with a concrete crash pad at the end. Authentic, inquiry-based learning opportunities such as these, that connect to the real world, consistently lead to increased curiosity, engagement, ownership of learning, and success for all of our students.

The NGSS and inquiry-based learning model both promote the inclusion of multi-tiered assessment methods that can be used to evaluate the effectiveness of instructional learning activities. While our newly implemented curriculum includes traditional formative and summative assessment strategies such as quick checks for understanding during an activity, exit tickets to gauge individual outcomes for a specific lesson, and end-of-unit multiple choice exams, it also includes performance assessments. Using this multi-tiered approach provides opportunities for all learners to demonstrate progress and for teachers to better understand the depth of student progress. Performance assessments are designed to assess not just knowledge but also synthesis and application of knowledge, and problem solving capabilities. For example, as a culminating physics performance assessment in 8th grade, student

teams must go through the iterative engineering process (designing, building, troubleshooting, and revising) to successfully create a functional marble roller coaster.

Our classrooms now foster environments that have a growth-mindset; where curiosity and passion rule over perfection and confidence takes root. Students learn about the iterative process of science and engineering where not only is it okay to fail, but somewhat expected as we try new things. Students are given the time and opportunity to reflect on their progress, then go back to make revisions and improvements to their models. They keep records of how their knowledge and understanding evolves and deepen over time as a result of the work they have put into the project. The goal is for students to leave MCMS understanding that no one is perfect, it is okay to fail, and that things always improve with reflection, continued learning, and persevering until you have a working solution to your problem.

A strong link to all stakeholders remains a critical component of any robust, successful curricular program. While our inquiry-based NGSS curriculum inherently links teachers and students, we have also implemented specific strategies to engage parents, our school community, our district, and the general public. These strategies start at the beginning of the year with Back to School Night presentations for parents that involve discussions about the new NGSS curriculum and the inquiry-based learning model. Throughout the school year, students are encouraged to share their learning experiences with parents by showing parents their SINQ (Science Interactive Notebook of InQuiry). Science teachers regularly post pictures and information about classroom activities on approved social media apps such as Twitter as a way to provide parents, our district, and the community with a snapshot of our inquiry-based classrooms. Parents are recruited to assist with Garden Club and NGSS lessons related to our school garden, as well as chaperone overnight science field trips (Outdoor Education, Catalina, Astrocamp**)** to get a firsthand look at NGSS science inquiry in action. Furthermore, we host MCMS Demonstration Day, a biannual event that invites parents and community members to come into our science classrooms and witness inquiry-based learning in action. We have experienced a very positive parent response to the full implementation of inquiry-based NGSS curriculum. Demonstration Day is always well attended and interactions with parents reveal stories of students who are excited about science. The new curriculum and all updates are shared with staff and the community at staff meetings, interdisciplinary departmental meetings, Site Council, Curriculum Council, and meetings with elementary and high school teachers for district-wide articulation.

Results of the Model

One of the positive outcomes of the Science Department writing an entirely new curriculum is that they were able to work together to develop student assessments used by all teachers in the same grade level. Gone are the days of each teacher writing and giving their own performance assessments with no way to accurately analyze student outcomes across the grade as a whole. We now have rubrics for performance

assessments as well as formative and summative assessments that are given to all students in the same grade level. Teachers on grade level teams meet regularly to compare the outcomes of these assessments in order to decide, as a team, how to proceed with the curriculum to ensure positive student outcomes. A truly effective Professional Learning Community, developed from the process, that promises long-term maintenance and progression for the Science programs.

One trend to note with the transition to NGSS is that our ELL and IEP students are having more success with the inquiry-based style of learning. The hands-on labs and modeling required with NGSS allow these students to gain a better understanding of the material when compared to the more traditional environment of taking notes, then memorizing concepts for a test.

Students get the chance to self-evaluate and make changes to their projects as units progress. Teachers get the chance to evaluate the final projects that have been drawn, built, or designed to show real-world, applied understanding of conte

Historically, Medea Creek has performed well on standardized state science tests such as the STAR, with the last reported scores in 2013 showing 95% of MCMS 8th grade students meeting or exceeding standards, and in prior years were consistently above 90%. We look forward to improving on this continued success on standardized assessments with on the CAST, but the real results of this implementation is the powerful and engaging methodology that is now employed throughout all our Science classes.