

STEMify Your Teaching

Best Practices of STEM Education in Your Classroom

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Owatonna Public Schools
Owatonna, MN

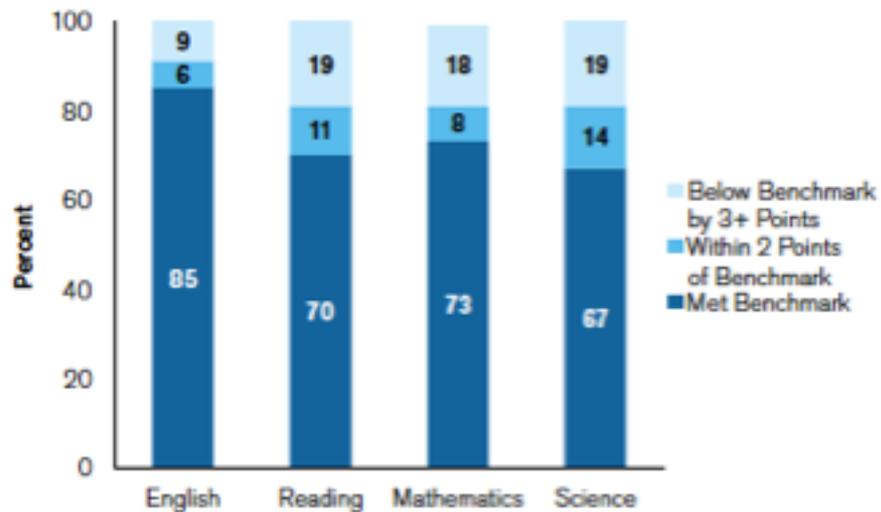
The status of STEM Education in MN

- Results of how students taking the ACT fared based on interest and performance in STEM fields on 2015 ACT exams.
- Differences in student interest and academic performance shows more divergence when examined by ethnicity.
- Results of this study did not explore if students had previous schooling in STEM.

Minnesota College Readiness

Expressed and Measured Interest (N = 8,865)

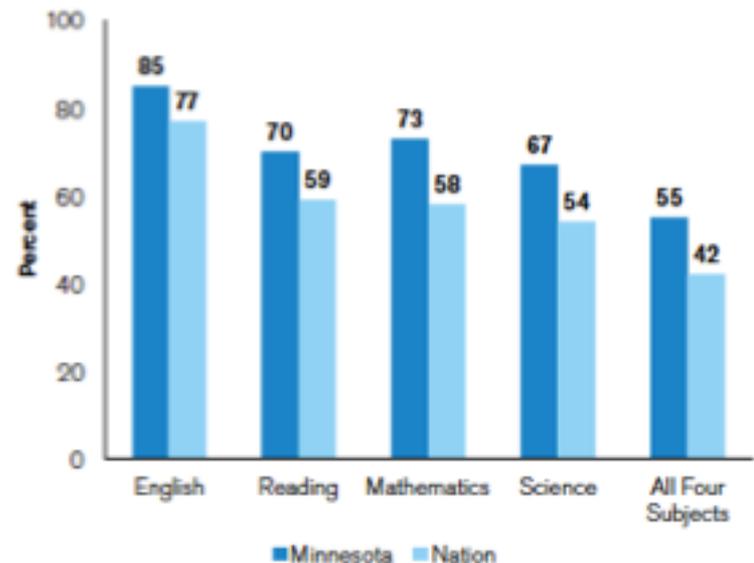
Percent of 2015 ACT-Tested High School Graduates by ACT College Readiness Benchmark Attainment and Subject



Expressed and Measured Interest

- 8,865 of your graduates have an expressed and measured interest in STEM, which is 38% of the overall interest.

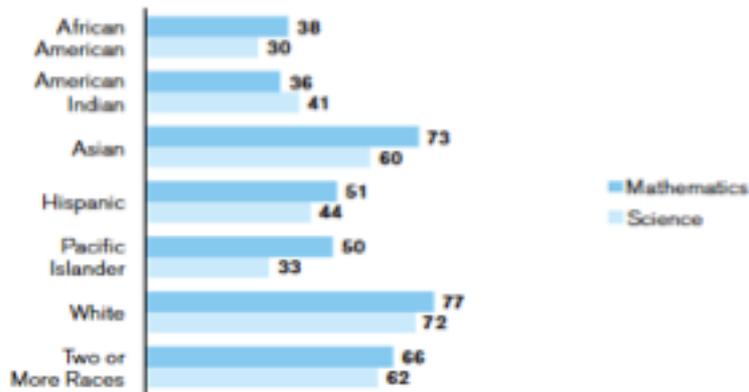
Percent of 2015 ACT-Tested High School Graduates Meeting ACT College Readiness Benchmarks by Subject



MN ACT data: ethnicity & gender

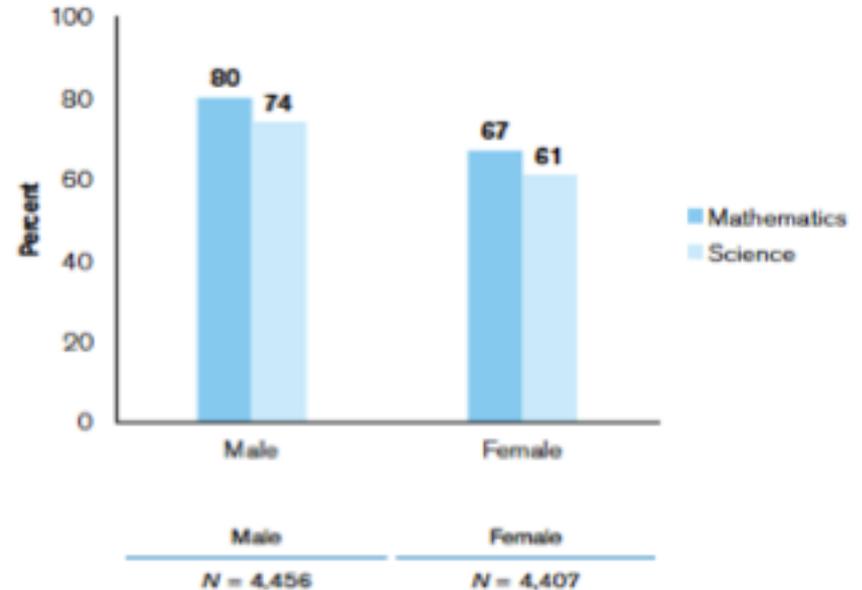
Expressed and Measured Interest

Percent of 2015 ACT-Tested High School Graduates Meeting ACT College Readiness Benchmarks by Race/Ethnicity and Subject*



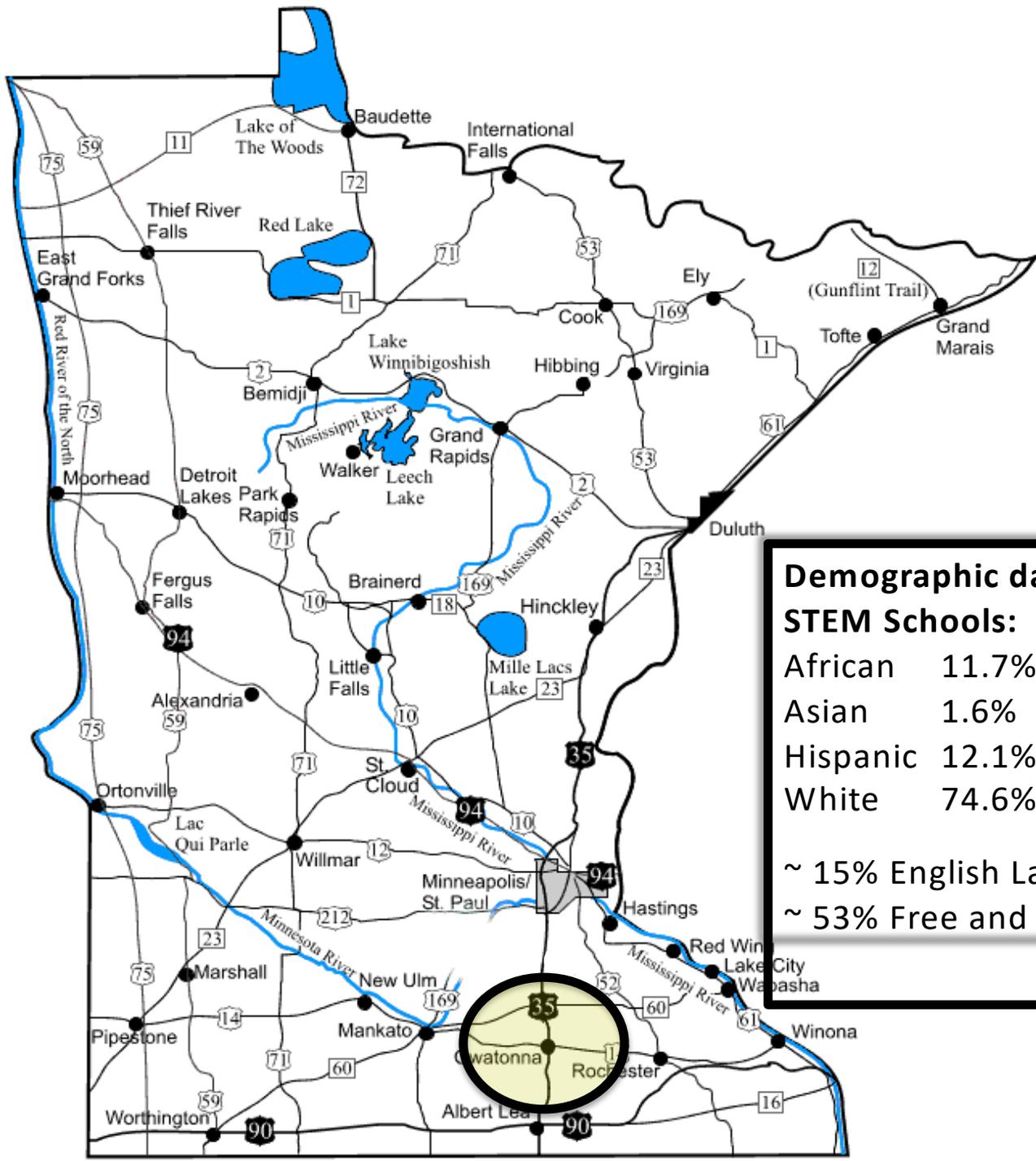
African American	American Indian	Asian	Hispanic	Pacific Islander	White	Two or More Races
N = 384	N = 44	N = 590	N = 416	N = 6	N = 6,821	N = 308

Percent of 2015 ACT-Tested High School Graduates Meeting ACT College Readiness Benchmarks by Gender and Subject



Key findings:

- Interest in STEM remains high, almost 49% of students taking ACT expressed interest.
- ACT Achievement levels are highest when students have both expressed and measured interest in STEM content.
- Female interest in STEM areas is high.
- Achievement levels in math and science need to improve.
- Interest in teaching STEM is declining, ACT is calling for well prepared STEM teachers!



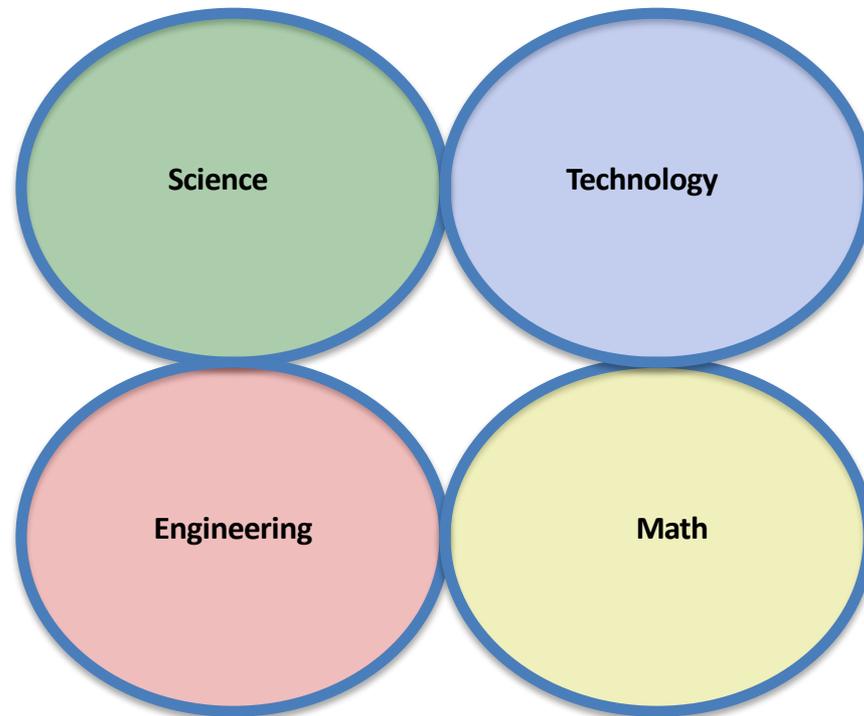
Demographic data for Owatonna STEM Schools:

African	11.7%
Asian	1.6%
Hispanic	12.1%
White	74.6%

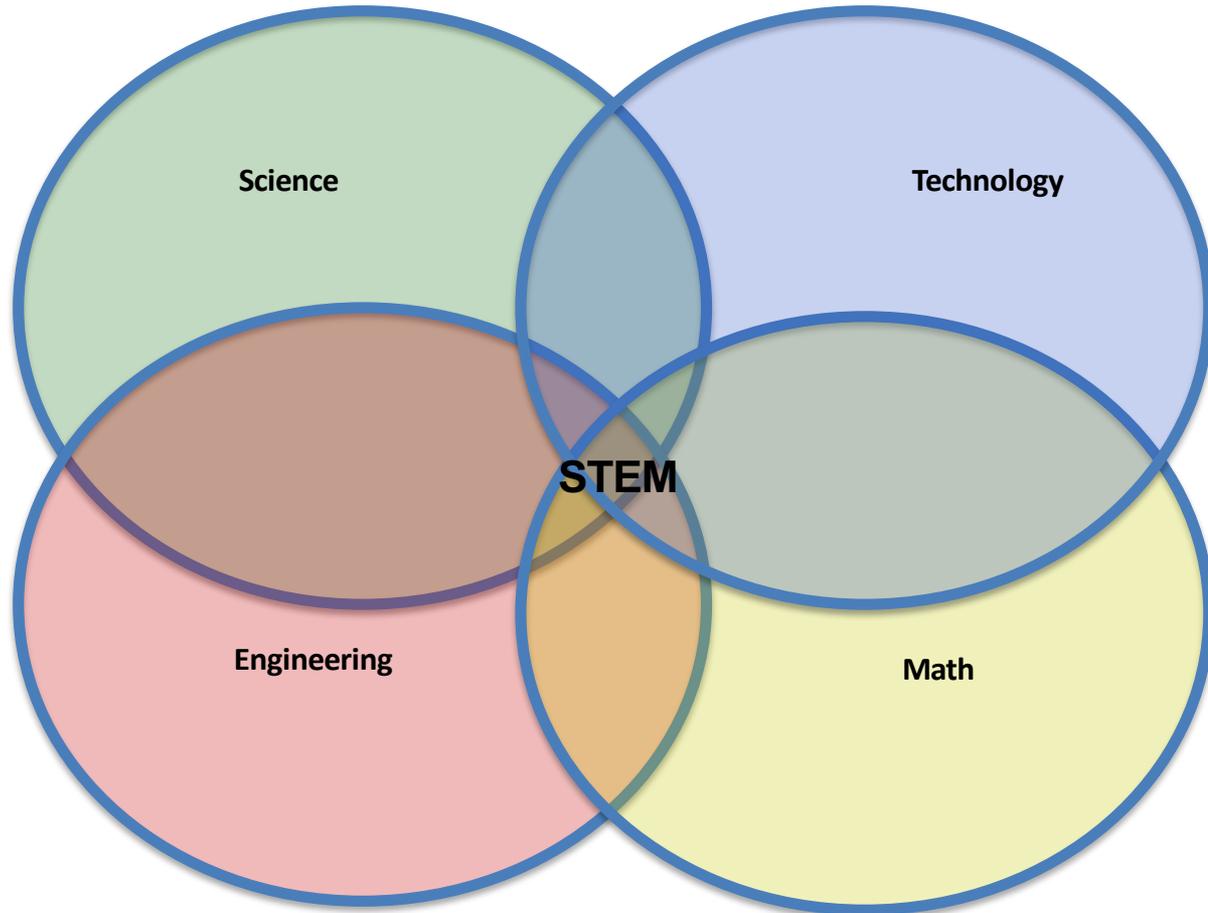
~ 15% English Language Learners
 ~ 53% Free and Reduced Lunch

Models of STEM Teaching & Learning

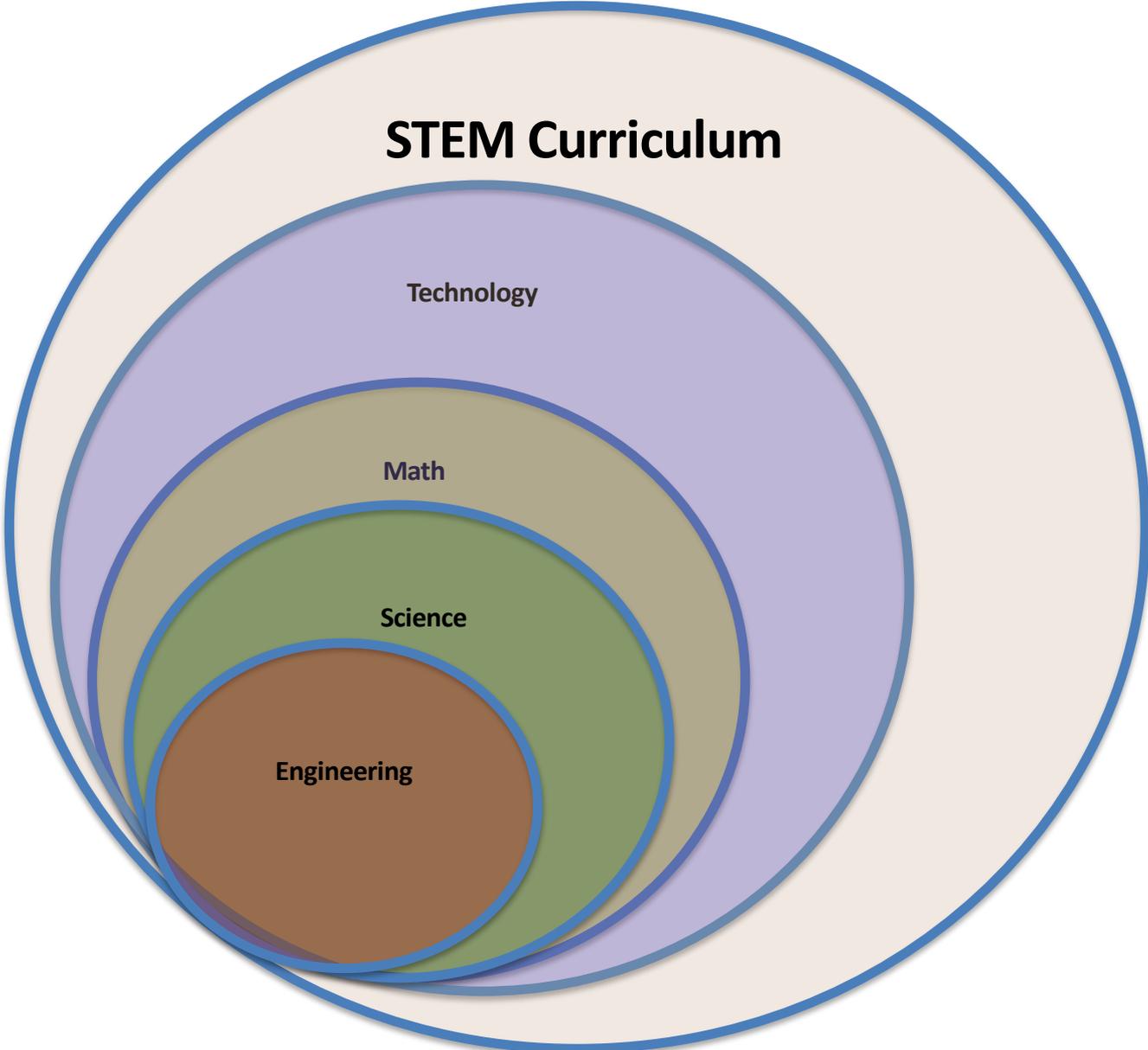
- Science, technology, engineering and math are taught, but are separate subjects.



STEM subjects are integrated.



STEM is embedded in all subject areas



The position of STEM within science education literature

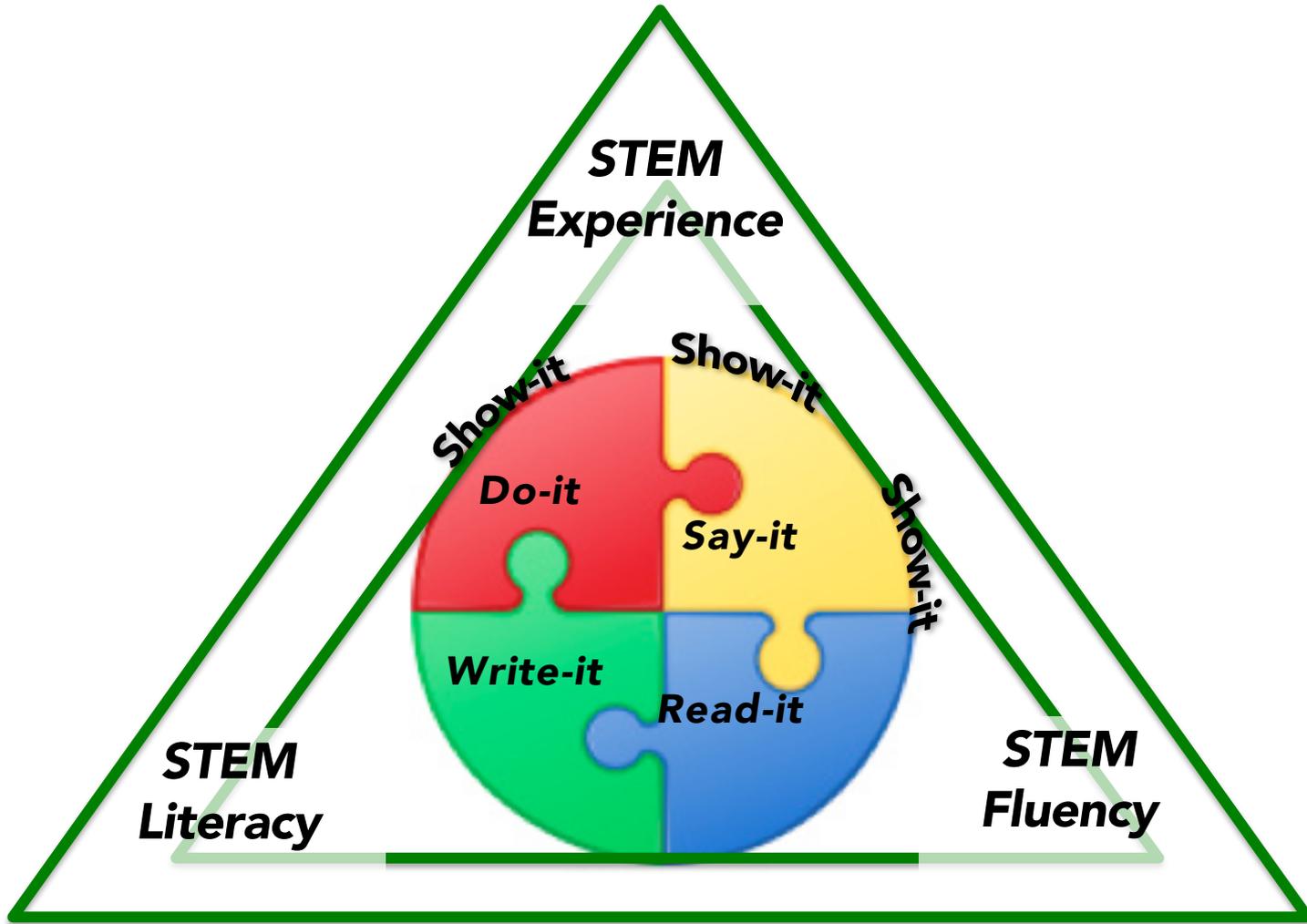
- Nationally, there are multiple definitions of STEM education with no clear defined description. However, researchers are calling for investigation into integrated STEM Teaching and Learning (English, 2016; Weld et. al, 2015; Saxton et.al, 2013)
- Since STEM educational initiatives are new for Minnesota schools, investigating their impact on teaching and learning is a burgeoning field of research (Gibson & Chase, 2002; Breiner, Harkness, Johnson & Koehler, 2012).
- It is important to understand student attitudes of how they perceive the experience of learning through STEM and the impacts of collaborative inquiry and integrated science, technology, engineering and math curriculum (Matson, DeLoach, & Pauly, 2004; Becker & Park, 2011).

What STEM means in Owatonna

- Teaching of STEM emphasizes integrated lessons where students solve problems and engineering challenges in all classes.
- STEM is embedded among all subject areas where all students can learn rigorous academic subject matter.
- Classes focus on students developing **growth-mindsets** and making mistakes is the launching point for real learning.
- Students recognize that lessons relate to real world learning.

Developing an Owatonna STEM model

- Lessons are designed for using STEM notebooks/journals to promote: ***STEM literacy & STEM fluency***
- However, shared ***STEM experience*** is essential to develop literacy and fluency skills.
- We want students to show-off their work. This allows for multiple forms of student dialogue and publication.
- When all these ideas are combined a STEM teaching and learning emerges:



A teaching / learning model for Owatonna STEM Schools

STEM model guides teaching and learning in all content areas such as:

- **Art & Perpich Foundation:** Integration of Arts into STEM lessons at all grade levels. Art teacher, Amanda Gislason, works closely with teachers K-5 to create integral art embedded STEM units.
- **Environmental Education:** “ESTEM”: Builds STEM learning on a foundation of environmental principles examining how society, culture and ecosystems interact.
- **Special Education:** Integrating STEM into IEP and inclusion learning creates opportunities for differentiation.
- **ELL:** Using STEM experience for front loading language development.
- **NEXUS:** Using STEM to address social & racial achievement gaps in student learning.
- **PAGE:** Addressing gender equity through STEM teaching and learning.
- **Physical Education & Music:** and engineering incorporate incorporating science into lessons.

STEM is about engaging students in interdisciplinary, problem solving.

- **Raising questions,**
- **Searching for answers,**
- **Working in teams,**
- **Arguing from evidence,**
- **Creating solutions,**
- **Building connections with real world applications both indoor and outdoor**
- **Experiencing shared common experiences.**

The STEM Acronym

- **Reexamining STEM in the light of how effective teaching and learning occurs.**
- **Scientific thinking, questioning and investigating**
- **T**echnology use and creation
- **E**ngineering design and problem solving
- **M**athematical computation, data analysis and interpretation

S+T+E+M=Learning

8 Elements of a STEM School

[\(University of Chicago STEM School Study, 2015\)](#)

- **Problem-based Learning** – Interdisciplinary Instruction, Student Reflection, Student Autonomy
- **Rigorous Learning** – Real-world Content, Staff-created Curricula, Cognitively Demanding Work
- **School Community and Belonging** – Atmosphere of Respect, Induction of New Students, Extracurricular Activities
- **Career, Technology, and Life Skills** – Early College Activities, Technology use by Students, Practice of Communication/Life Skills
- **Personalization of Learning** – Differentiation, Follow Student Interests, Use of Formative Assessments
- **External Community** – Community Presence, Service Learning, Teachers Sharing Practices
- **Staff Foundations** – Collaboration, Reflection, Leadership
- **Essential Factors** – Flexible/Open to Change, Representative Student Population, Professional Development

How we design & build effective STEM teaching & learning

- ***Teachers work in collaborative grade level teams*** with shared prep times (usually).
- ***Bi-weekly PLC meetings*** that focus on data collected from formative & summative assessments.
- ***Sub-out days during the school year*** provide for common & creative planning to “STEMify” our curriculum.
- ***Continual PD*** with resources such as Jeffers Foundation, Perpich Foundation for Arts Integration, National Center for STEM Elementary Education, & University of MN STEM Education Center.

Working with Owatonna STEM Teachers

- Four stations, each for different grade levels
- Teachers have brought materials from their classrooms to share and discuss
- Each station will be focused on discussion, question answering and dialogue:
 - **Michelle Simon**, 1st grade teacher: Focus group K-2 & STEM Certification through the NCSEE @ St. Kate's University
 - **Kayla Davis**, 3rd grade: Focus Group 3-4 & Technology integration
 - **Libby Zeman**, Literacy Instructional Coach: Focus group 4-5 & Literacy K-5
 - **Josh Tolle**, 6th grade: Focus group: 6-8 Science, Literacy, Access & Equity through the Science Museum of Minnesota PAGE program

Responses to student attitudes towards STEM Education survey

Mean scores from grades 4-8 for students responses of “Agree to Strongly Agree”:

- “I am good at math” : 70.2%
- “I know I can do well at science.”: 68.6%
- “I believe I can be successful at engineering.”: 57.2%
- “Knowing how to use math and science together will help me invent useful things.”: 66.9%
- “I am confident that I can produce high quality work.”: 74.0%
- “I can work well with students who are different from me.” 80.0%