Integrated STEM

"SCIENTISTS INVESTIGATE THAT WHICH ALREADY IS;
ENGINEERS CREATE THAT WHICH HAS NEVER BEEN."

ALBERT EINSTEIN

NYS Science Learning Standards: Science and Engineering Practices

- Asking questions (for science) and defining problems (for engineering)
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations (for science) and designing solutions (for engineering)
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

NYSSLS—Engineering Design

Grades K-2

- Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
- Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem
- Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

Grades 3-5

- Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost
- Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Oceanside's Model

How does STEM fit in the school day?
- Two hour blocks for six consecutive days in each classroom

What does professional development look like?
- Co-teaching with Lead STEM teacher and classroom teacher to implement integrated STEM and student centered strategies
- Professional Development Workshops
- De-briefing sessions with principal, classroom teacher and STEM teacher

How do you create an integrated STEM challenge?

- Utilize grade level curriculum content and skills in math and science and other subject disciplines
- Incorporate Problem-Solving:
  - Awareness of specifications and constraints
- Incorporate the Inquiry Design Model
  - Compelling Question
    - When is a problem solved?

Roller Coaster Physics – Math and Science

1. Potential and Kinetic Energy--Ball and Ramp
2. Newton's Law of Inertia, and Newton's Third Law
3. Forces— Centripetal, Gravity, Friction
4. Science practices - using models: Simulation
   http://contentx.lason.org/resource_content/content/digitallab/a8cri/misc_content/public/coaster.html
5. Addition and subtraction with decimals
6. Linear and Angle Measurement

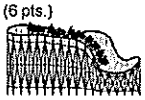
Grade 4 -Roller Coaster Physics Design Challenge

Ms. Thrilla, the owner of the "Ride of Your Life" Amusement Park needs your help in designing the optimal roller coaster ride. She will need for you to create a model of a roller coaster, using just foam pipe insulation and a marble. It must include at least one loop and no more than two loops. You have three two hour class periods to design the optimal coaster. The roller coaster model will be judged on the following:

Safety: the marble must stay on the track at all times (6pts.)

Fun:

- **Length of Ride** – the longest ride is the most fun (6 pts.)
- **# of Loops** –the more loops the more fun
  - 1 loop = 1 pt.
  - 2 loops = 2 pts.



The Design Portfolio

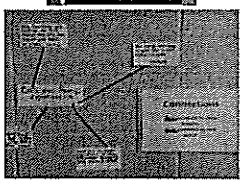
• Specs (What it has or does)	• Constraints (Its limitations)
• The marble must stay on the track at all times • It must stop at the end • It must have a rise and a run • It must have between 1-2 loops	• Budget: $20.00 • Materials: Ms. Thrilla's materials only • Time: 2 hours

Occupations

- **Accountant** – maintains balance sheet
- **Materials Consultant**—obtains and returns materials
- **Organizer**—head problem-solver
- **Measurer**—uses measuring tools
- **Sketcher**—draws last diagram for replication and makes connections on the wall
- **Recorder**—lists modifications
- **Researcher**—investigates science and math

Strategies for promoting student-centered learning

- **Student as facilitator**
- **CHIME**
- **Parking Lot of Ideas**
- **Connection Wall**
- **Student as questioner**

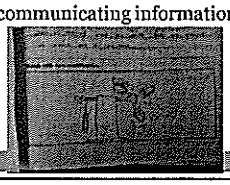


Real Classrooms

https://www.teachingchannel.org/videos/teaching-stem-strategies

Grade 5: Harnessing the Wind Science

1. Forms of Energy – Electromagnetism, Mechanical, Wind, Electric, and Light
2. Bernoulli's Principle
3. Transfer of Energy
4. Science practices - using models: Biomimicry, Planning and carrying out investigations, and Obtaining, evaluating, and communicating information



Harnessing the Wind - Mathematics

1. Volume of a rectangular solid
2. Percent
3. Addition, subtraction, multiplication and estimation with decimals
4. Using a protractor- angle measurement
5. Finding unit price

Grade 5 Harnessing the Wind
Windmill Design-

~~Five consecutive sessions~~ ~~2 ½ hours each session~~

Part 1:
Help William test the ability for the windmill to use mechanical energy to lift a bucket. The windmill must be sturdy. It must have at least two blades and no more than six blades. You must use the materials provided. You have 20 minutes to complete this challenge. You have a $15.00 budget. You may not alter any blade original design for this first challenge. You may use remaining monies for the next part of the challenge. Good Luck!

Part 2: Now your windmill must carry an eight cubic cm. load

Part 3: Triple your load, using the "water" beads in your bucket. Don't forget to utilize your knowledge of Biomimicry.

Part 4: Light a bulb using wind energy

Harnessing the Wind Materials Sheet

Harnessing the Wind Materials Sheet 1

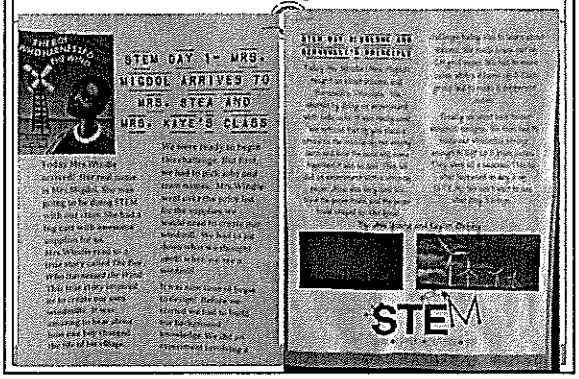
Wind Mill Costs

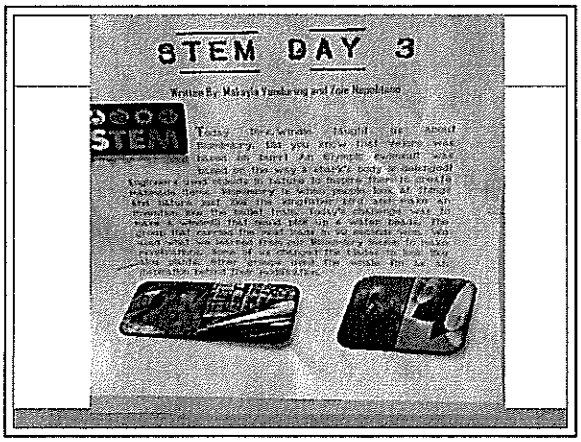
Rentals ..... (scissors, rulers, measuring tape, plastic cups, protractors, fan, stopwatch, C-Clamps, goggles)	$2.75 per day
Marbles	Two for $1.20
Black String	$0.75 per decimeter
Duct/Masking Tape	$1.00 per decimeter
Oak Tag Blades	$4.80 for four
Wooden Blades	$ 4.20 for three
Clear Plastic Blades	$ 2.50 for two
Foam Core Blades	$ 2.75 for two
Wooden Spokes	$2.00 for four
Wind Mill Stand	$2.50 per day

Ways to EARN Money

○ Team Building	$2.25 per day
○ Evidence of making one modification at a time	.$1.50 per modification
○ Research Sharing	$1.50 per "student"
○ Accounting	$1.50 per day
○ Estimation	$1.00 per estimate
○ Teaching others	$1.00 per "student"

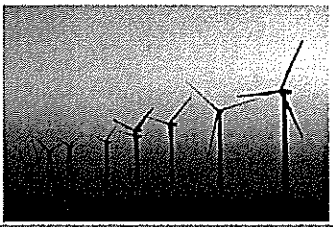
ELA Integration





The Great Debate

Wind Turbines: LI Offshore Wind Project
Now that we can, should we?



Student Reflections...

- I'm a good engineer, and I know now that if I try hard, I can do anything!
- I am a great listener and speaker. I am more creative than I ever thought I was.
- I learned that sometimes I can take over without even knowing it. I really want to try to stop doing that. I also learned that I can sometimes try to help other teams to help them make their coaster better.
- I am good at computation. Being the accountant was an important job because everyone depended on me.

Sixth Grade STEM next year .... Six two-hour sessions per class

Utilizing SCRATCH program students will

- Learn how to code
- Use the Design Process to
  - Create a game design
  - Sprites will
    - Interact
    - Move in certain directions using coordinate geometry
    - Have sound and "talk"
    - Attain a goal

Thank you

Robert Fenter
Assistant Superintendent for Curriculum, Instruction, and Research
rfenter@oceansideschools.org

Donna Migdol
STEM Teacher
dmigdol@oceansideschools.org

Kathy Chapman
Director of Science, K-12
kchapman@oceansideschools.org