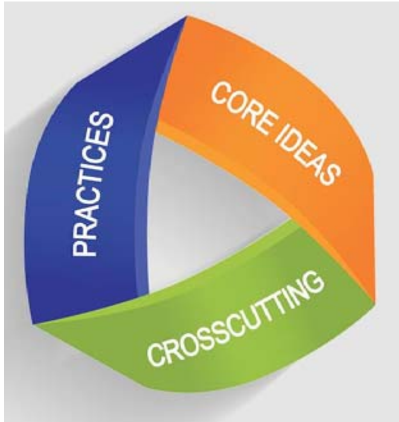
Oyster Bay-East Norwich Elementary Science and Technology

“The important thing is to not stop questioning.”

~Albert Einstein

Context: Next Generation Science Standards (NGSS)

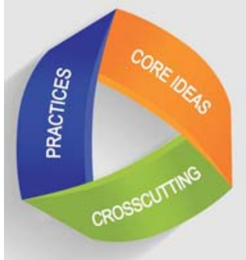
- Based on National Academy of Sciences "A Framework for K-12 Science Education," 2011
- Provide performance expectations related to "3-Dimensional Learning"
- Movement towards exploratory instead of confirmatory experimentation
- Anchor student performance expectations on
  1) Scientific and engineering practices
  2) Core disciplinary ideas
  3) Cross-cutting concepts



Next Generation Science Standards

Student performance expectations based on

1) Scientific and engineering practices
2) Core disciplinary ideas
3) Cross-cutting concepts



3. Forces and Interactions

Students who demonstrate understanding can:

3-PS2-1. **Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.** [Clarification Statement: Examples could include an unbalanced force on one side of an object can make it start moving; and, balanced forces (including friction) acting on a stationary object from both sides will not produce any motion at all.] [Assessment Boundary: Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force size, only qualitative and relative. Assessment is limited to gravity being addressed as a force that pulls objects down.]

3-PS2-2. **Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.** [Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a see-saw.] [Assessment Boundary: Assessment does not include technical terms such as period and frequency.]

3-PS2-3. **Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.** [Clarification Statement: Examples of an electric force could include the force on hair from an electrically charged balloon and the electrical forces between a charged rod and pieces of paper; examples of a magnetic force could include the force between two permanent magnets, the force between an electromagnet and steel paperclips, and the force exerted by one magnet versus the force exerted by two magnets. Examples of cause and effect relationships could include how the distance between objects affects strength of the force and how the orientation of magnets affects the direction of the magnetic force.] [Assessment Boundary: Assessment is limited to forces produced by objects that can be manipulated by students, and electrical interactions are limited to static electricity.]

3-PS2-4. **Define a simple design problem that can be solved by applying scientific ideas about magnets.*** [Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

K-12 “3-Dimensional Learning”

Science and Engineering Practices (8)	Disciplinary Core Ideas (44 Total)	Cross-Cutting Concepts (7)
1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating and communicating information	Earth and Space Science Life Science Physical Science Engineering, Technology, and Applications of Science	1. Patterns 2. Cause and Effect: Mechanism and Prediction 3. Scale, Proportion and Quantity 4. Systems and System Models 5. Energy and Matter: Flows, Cycles and Conservation 6. Structure and Function 7. Stability and Change

3. Forces and Interactions

Students who demonstrate understanding can:

3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. [Clarification Statement: Examples could include an unbalanced force on one side of an object can make it start moving; and, balanced forces (including friction) acting on a stationary object from both sides will not produce any motion at all.] [Assessment Boundary: Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force size, only qualitative and relative. Assessment is limited to gravity being addressed as a force that pulls objects down.]

3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. [Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a see-saw.] [Assessment Boundary: Assessment does not include technical terms such as period and frequency.]

3-PS2-3. Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. [Clarification Statement: Examples of an electric force could include the force on hair from an electrically charged balloon and the electrical forces between a charged rod and pieces of paper; examples of a magnetic force could include the force between two permanent magnets, the force between an electromagnet and steel paperclips, and the force exerted by one magnet versus the force exerted by two magnets. Examples of cause and effect relationships could include how the distance between objects affects strength of the force and how the orientation of magnets affects the direction of the magnetic force.] [Assessment Boundary: Assessment is limited to forces produced by objects that can be manipulated by students, and electrical interactions are limited to static electricity.]

3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets.* [Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.
- Ask questions that can be investigated based on patterns such as cause and effect relationships. (3-PS2-3)
- Define a simple problem that can be solved through the development of a new or improved object or tool. (3-PS2-4)

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.
- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-PS2-1)
- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (3-PS2-2)

Connections to Nature of Science

Science Knowledge is Based on Empirical Evidence
- Science findings are based on recognizing patterns. (3-PS2-2)

Scientific Investigations Use a Variety of Methods
- Science investigations use a variety of methods, tools, and techniques. (3-PS2-1)

Disciplinary Core Ideas

PS2.A: Forces and Motion
- Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) (3-PS2-1)
- The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.) (3-PS2-2)

PS2.B: Types of Interactions
- Objects in contact exert forces on each other. (3-PS2-1)
- Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other. (3-PS2-3),(3-PS2-4)

Crosscutting Concepts

Patterns
- Patterns of change can be used to make predictions. (3-PS2-2)

Cause and Effect
- Cause and effect relationships are routinely identified. (3-PS2-1)
- Cause and effect relationships are routinely identified, tested, and used to explain change. (3-PS2-3)

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology
- Scientific discoveries about the natural world can often lead to new and improved technologies, which are developed through the engineering design process. (3-PS2-4)

Connections to other DCIs in third grade: N/A

Articulation of DCIs across grade-levels: **K.PS2.A** (3-PS2-1); **K.PS2.B** (3-PS2-1); **K.PS3.C** (3-PS2-1); **K.ETS1.A** (3-PS2-4); **1.ESS1.A** (3-PS2-2); **4.PS4.A** (3-PS2-2); **4.ETS1.A** (3-PS2-4); **5.PS2.B** (3-PS2-1); **MS.PS2.A** (3-PS2-1),(3-PS2-2); **MS.PS2.B** (3-PS2-3),(3-PS2-4); **MS.ESS1.B** (3-PS2-1),(3-PS2-2); **MS.ESS2.C** (3-PS2-1)

Common Core State Standards Connections:

ELA/Literacy –

RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. *(3-PS2-1)*,(3-PS2-3)
RI.3.3 Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. (3-PS2-3)
RI.3.8 Describe the logical connection between particular sentences and paragraphs in a text (e.g., comparison, cause/effect, first/second/third in a sequence). *(3-PS2-3)*
W.3.7 Conduct short research projects that build knowledge about a topic. (3-PS2-1),(3-PS2-2)
W.3.8 Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (3-PS2-1),*(3-PS2-2)*
SL.3.3 Ask and answer questions about information from a speaker, offering appropriate elaboration and detail. *(3-PS2-3)*

Mathematics –

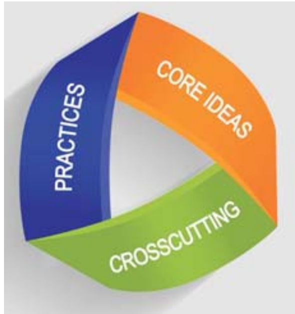
MP.2 Reason abstractly and quantitatively. *(3-PS2-1)*
MP.5 Use appropriate tools strategically. *(3-PS2-1)*
3.MD.A.2 Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem. *(3-PS2-1)*

NGSS Grade 3:

Physical Science "Core Ideas"
- 4 performance expectations
- Overlaps with current 4th grade unit

Life Science "Core Ideas"
- 8 performance expectations
- Overlaps with current 3rd and 4th grade units

Earth Science "Core Ideas"
- 2 performance expectations
- Overlaps with current 4th grade unit



OBEN Curricular Overlap With New Standards

- K-12 Science education reflects the interconnected nature of Science as it is practiced and experienced in the real world.

- The NGSS focus on deeper understanding of content as well as application of content.

Motivators for Change in OBEN Science

- Integration of engineering and design (2013-ongoing)

- Alignment of grade-specific standards and curricular development (2016-2018)

Engineering and Design in OBEN Science

- Long Island Science, Technology, Engineering and Math Educational Leadership Association (LISTEMELA) conference presentation

  “Creating a Hotbed for Engineering in Our Elementary Classrooms”
  Regina D’Orio, Keith Harrison, Diana Hauser, and Janna Ostroff

  1) “STEM-ify” existing units and incorporation of “Engineering is Elementary”
  2) Coding and robotics curricular initiatives
  3) Makerspaces

- Makerspaces

  Theodore Roosevelt (Regina D’Orio, Mrs. McElwee and the TR Community)

  James H Vernon (Patricia Murray, Diana Hauser, Kevin Cotter, Nancy Flatley, Kelly Hilt, Maria Malzone and Dr. Vacchio along side the entire Vernon community)

"Stem-ify" Science Units at TR

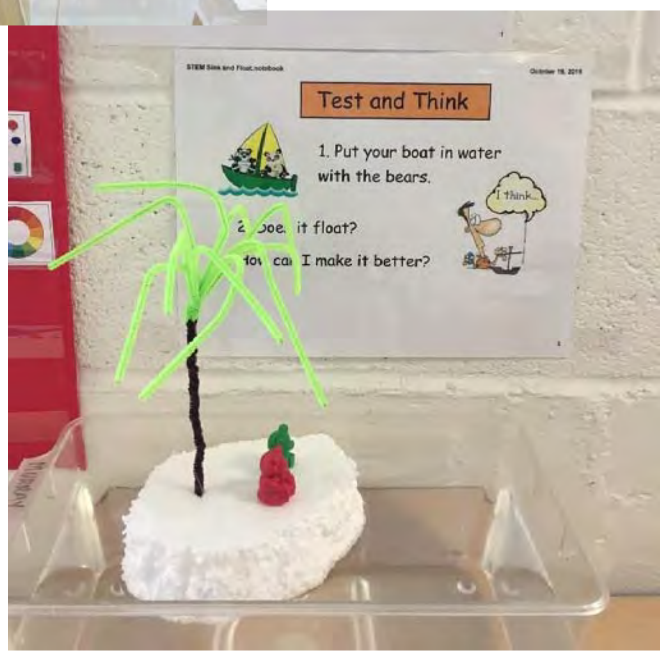
Kindergarten Properties: Sink and Float

Design Challenge: Test materials, design and build a boat that will float to save the bears from the island.

Grade 2 Matter: States of Matter

Design and build a spacecraft that can land on Oobleck without sticking and carry 2 linker cubes of cargo.

Benefits:
Deepen learning, engage students in engineering, and critical thinking

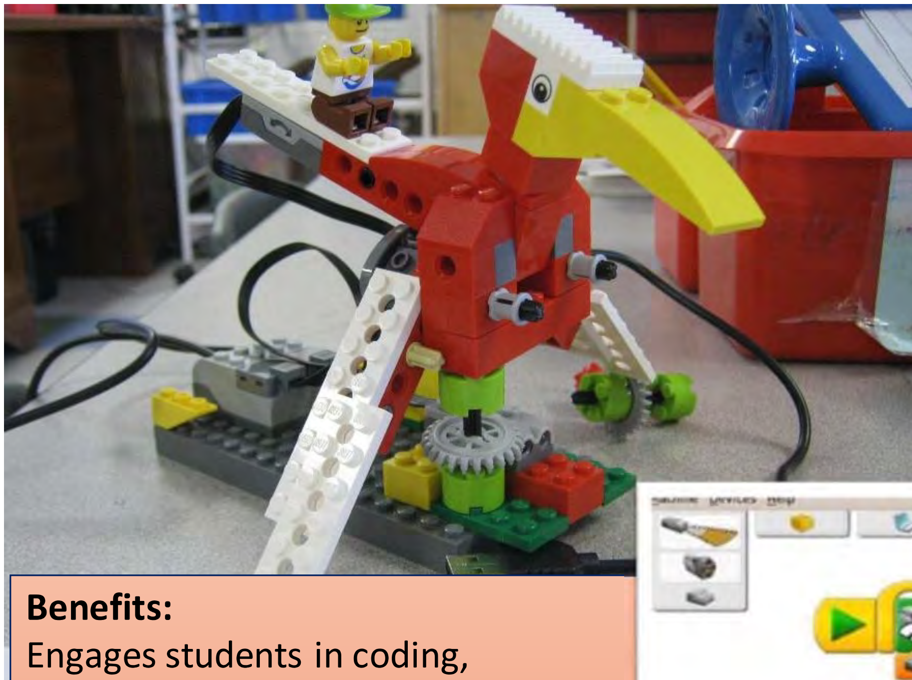


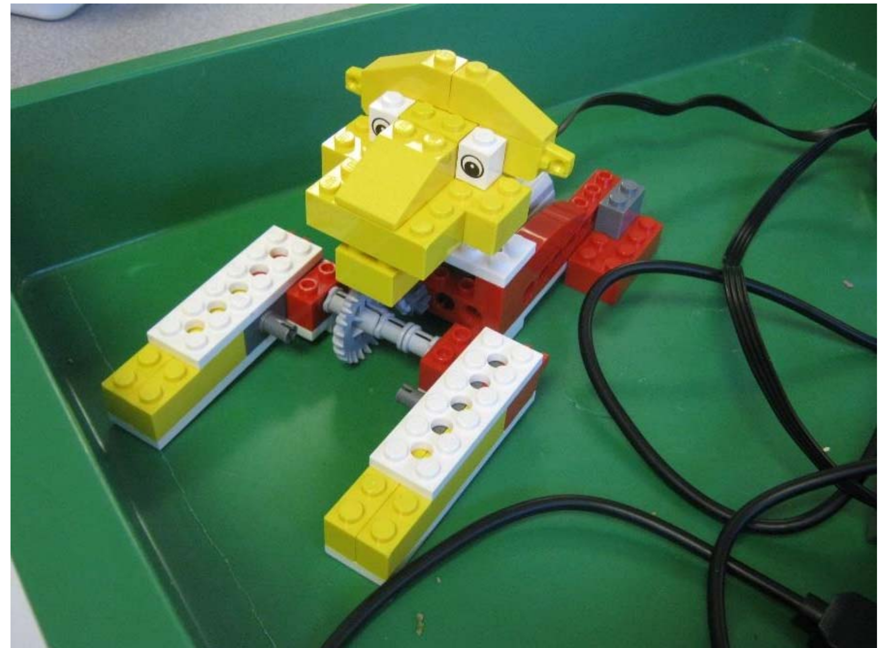
TR Makerspace Cart

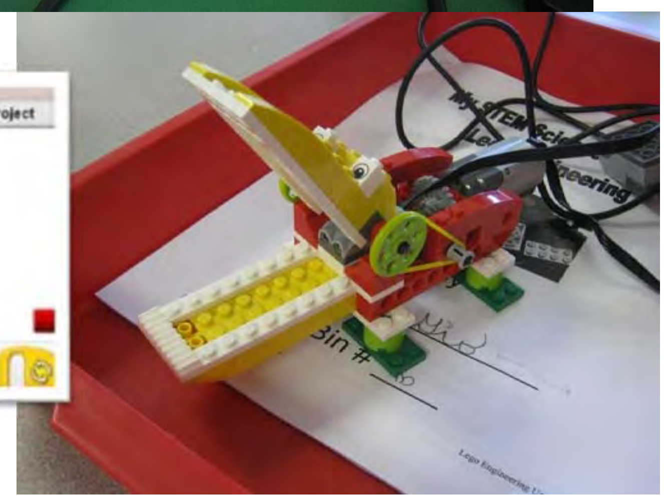
Makerspace Cart

Benefits:
Learn problem solving, being creative, try, try again!

TR Coding and Building

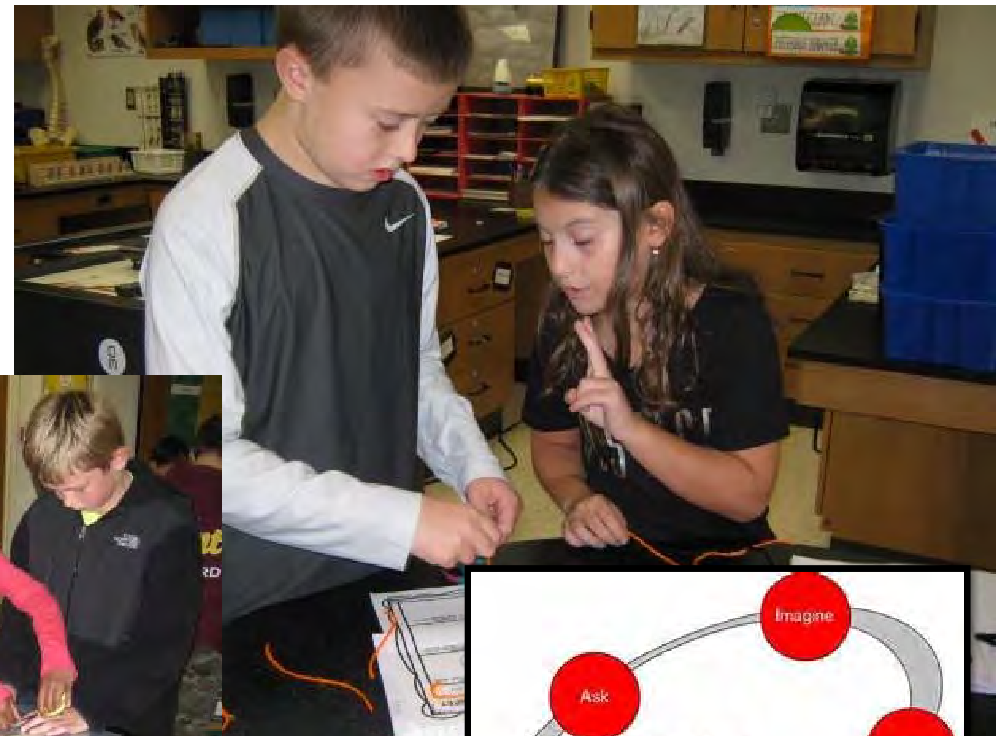




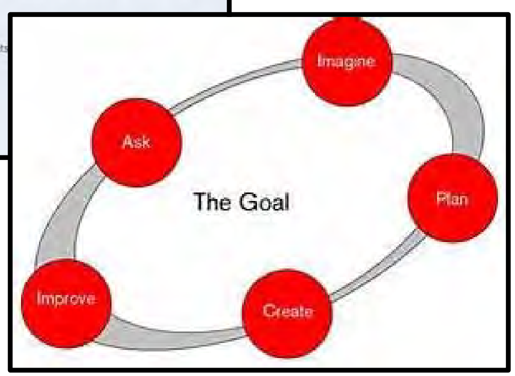


Benefits:
Engages students in coding, programming, sequential thinking, building, and redesign to optimize function of models

“STEM-ify” Science Units at Vernon



Vernon's Engineering is Elementary (EIE) Initiatives



- Units foster problem solving skills by applying the "Engineering Design Process"
- Students are presented with a problem, criteria, and constraints for each project.
- SAMPLES: Pollination, Electricity/Alarms, Simple Machines, Windmills, Membranes, Parachutes, etc.

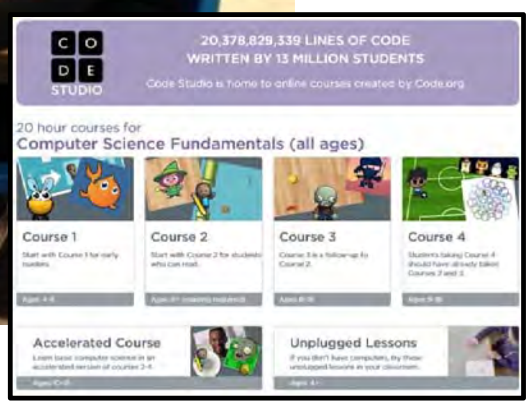

Windmills
I BROUGHT THE
AWESOME
PROPERTY OF
67
POLO RL


Membranes

Coding at Vernon

- Technology “Special” Content: Word, PowerPoint, Excel, Publisher, internet safety, cyberbullying, keyboarding, searching strategies, blogging, etc.
- “Hour of Code” (2013 – forever!)
- Started by inviting families:

“Parents as Programming Partners”



Success of Year 1 Initiative

⬇

Positive Feedback

⬇

Student Engagement and Gratification

⬇

Inclusion/Expansion of Coding In Curricula

ex: Looping, Algorithms, Debugging, Conditions, Variables

Lego Mindstorms EV3

- Used in grades 4-6 (3rd grade using WeDo)
- Extension of the coding work students are doing
- Students worked during indoor recess to build robots
- Focused on the programming side of robotics
- EV3 Software-Robot Educator

http://ev3lessons.com/lessons.html#en-us

http://curriculum.cs2n.org/ev3/index.html

Vernon Makerspace

School-Wide Goal: Create a place where the students solve a problem, explore, create, make mistakes and improve!

Grade-Based Challenge (Spring, 2016):

- 3rd Grade: Red Riding Hood's Light Source
- 4th Grade: Angry Birds Race Cars
- 5th Grade: Cain's Arcade Games

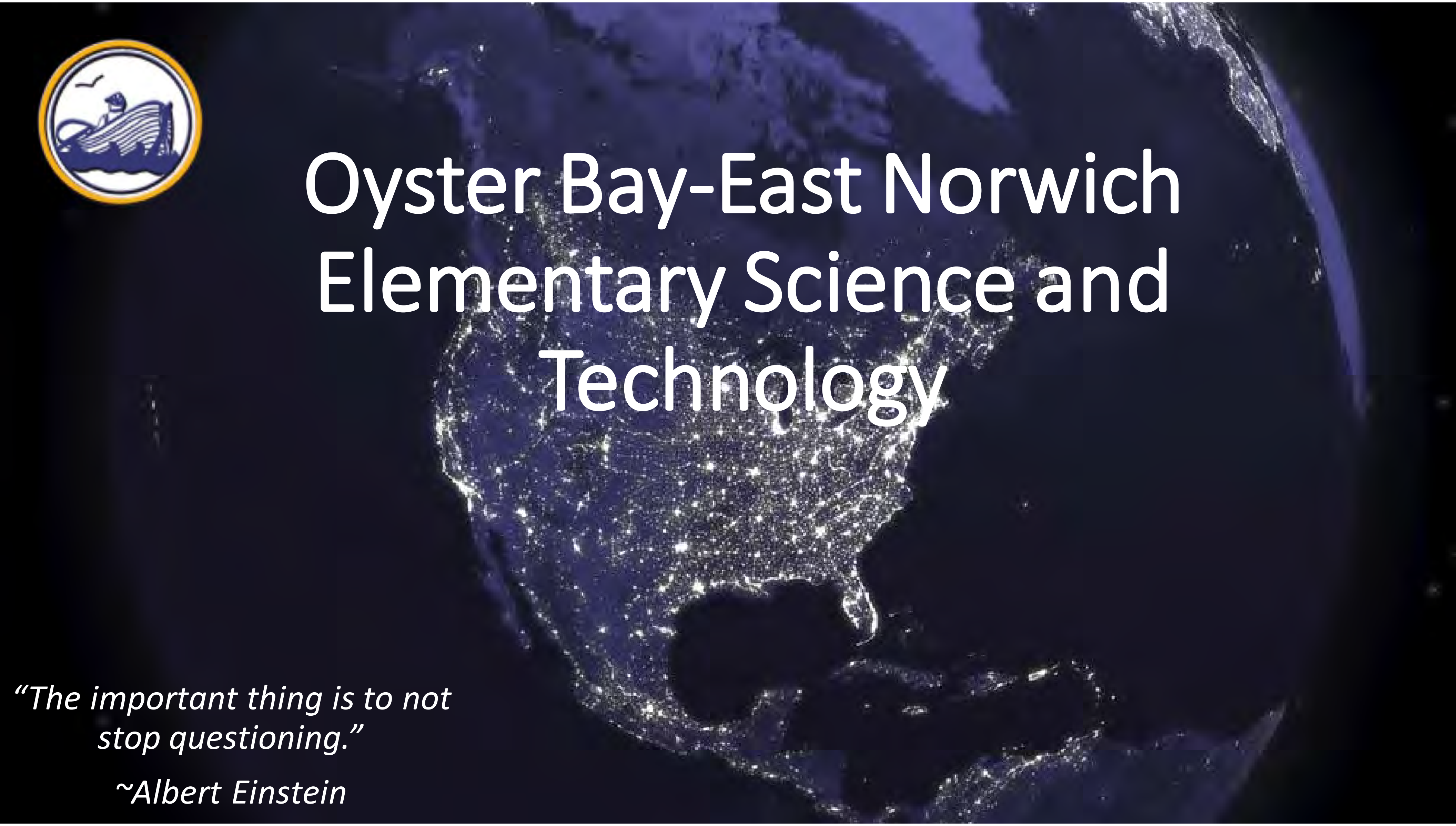
Enrichment Option and Open for Teacher Sign-Up (2016-2017)

Makerspace Materials Acquired Through:

- Recycled Materials from Community
- Student-Provided Materials
- Innovation Grant (Squishy Circuits and Dot and Dash Robots)
  Diana Hauser and Kevin Cotter
- Donors Choose (10 iPads)
  2015-16 Site-Based Teachers Diana Hauser, Nancy Flatley and Kelly Hilt

Arcade Fair: Created by Grade 5

Makerspace Enrichment and Teacher Sign-Out


Oyster Bay-East Norwich Elementary Science and Technology
“The important thing is to not stop questioning.”
~Albert Einstein