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Legislative Finance Committee

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Los Alamos Public Schools

July 18, 2018

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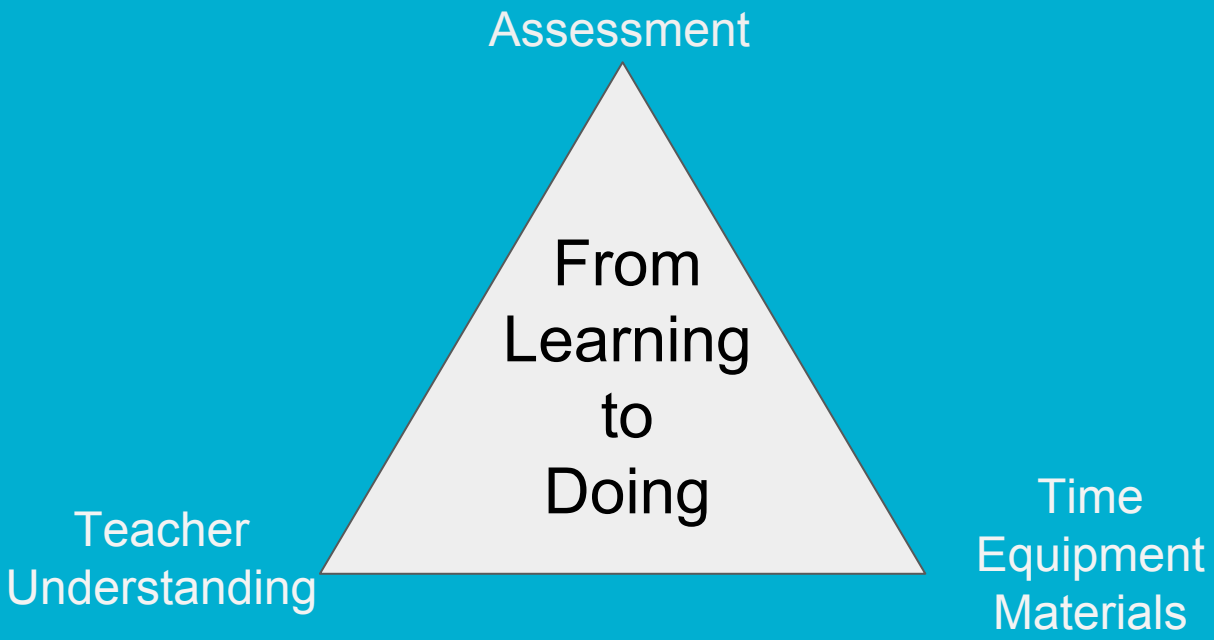
Implementing NGSS: Next Gen Science Standards



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From Learning to Doing

Old New Mexico Science Standards:

- Content-based = about science
- Mile wide, inch deep
- Lecture driven
- Students are observers
- Teacher-directed
- 1 dimension to learning
  - Memorization of science facts

NGSS/Next Gen Science Standards:

- Process-based = doing science
- Fewer concepts, more depth
- Project driven
- Students are participants
- 3 dimensions to learning
  - Disciplinary Core Ideas
  - Science and Engineering Practices
  - Crosscutting Concepts (patterns, scale, cause-effect, and so on)

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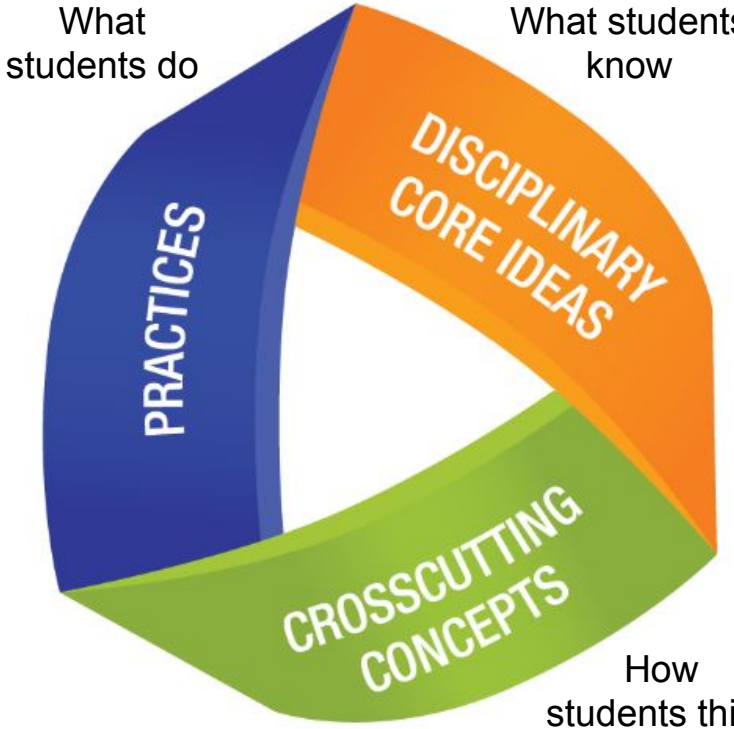
What is NGSS?

3 Dimensions to Learning- Next Generation Science Standards

Ask questions
Design investigations
Collect, analyse, and interpret data
Develop and use models
Construct evidence based models
Define and design a problem
Apply knowledge to engineer solutions to a problem



Life Science
Earth and Space Science
Physical Science
Engineering, technology, and Application of Science

Patterns
Cause and effect
Scale, proportion and quantity
Systems and models
Emergy and matter
Structure and function

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From Learning to Doing

Old New Mexico Science Standards

Third Grade Science Standards and Benchmarks

Standard #2: Content of Science
Definition II (Life Science): Understand the properties, structures, and processes of living things and the interdependence of living things and their environments.

Benchmark #2: Know that living things have similarities and differences and that living things change over time.	Performance Objective 1	☐ Identify how living things cause changes to the environments in which they live, and that some of these changes are detrimental to the organism and some are beneficial.
	Performance Objective 2	☐ Know that some kinds of organisms that once lived on Earth have become extinct (e.g., dinosaurs) and that others resemble those that are alive today (e.g., alligators, sharks).

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NGSS: Next Generation Science Standards

3.Interdependent Relationships in Ecosystems

3.Interdependent Relationships in Ecosystems
Students who demonstrate understanding can:

3-LS4-1. **Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.** [Clarification Statement: Examples of data could include type, size, and distributions of fossil organisms. Examples of fossils and environments could include marine fossils found on dry land, tropical plant fossils found in Arctic areas, and fossils of extinct organisms.] [Assessment Boundary: Assessment does not include identification of specific fossils or present plants and animals. Assessment is limited to major fossil types and relative ages.]

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NGSS: Next Generation Science Standards

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

Analyzing and Interpreting Data
Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.

- Analyze and interpret data to make sense of phenomena using logical reasoning. (3-LS4-1)

Engaging in Argument from Evidence
Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed worlds.

- Construct an argument with evidence, data, and/or a model. (3-LS2-1)
- Construct an argument with evidence. (3-LS4-3)
- Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem. (3-LS4-4)

Disciplinary Core Ideas

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die. *(secondary to 3-LS4-4)*

LS2.D: Social Interactions and Group Behavior

- Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size. *(Note: Moved from K–2)* (3-LS2-1)

LS4.A: Evidence of Common Ancestry and Diversity

- Some kinds of plants and animals that once lived on Earth are no longer found anywhere. *(Note: Moved from K–2)* (3-LS4-1)
- Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments. (3-LS4-1)

LS4.C: Adaptation

- For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. (3-LS4-3)

LS4.D: Biodiversity and Humans

- Populations live in a variety of habitats, and change in those habitats affects the organisms living there. (3-LS4-4)

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships are routinely identified and used to explain change. (3-LS2-1),(3-LS4-3)

Scale, Proportion, and Quantity

- Observable phenomena exist from very short to very long time periods. (3-LS4-1)

Systems and System Models

- A system can be described in terms of its components and their interactions. (3-LS4-4)

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology

- Knowledge of relevant scientific concepts and research findings is important in engineering. (3-LS4-4)

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes consistent patterns in natural systems. (3-LS4-1)

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NGSS: Next Generation Science Standards

NGSS offers Connections to Common Core Math and English Language Arts Standards

Connections to other DCIs in third grade: **3.ESS2.D** (3-LS4-3); **3.ESS3.B** (3-LS4-4)

Articulation of DCIs across grade-levels: **K.ESS3.A** (3-LS4-3)(3-LS4-4); **K.ETS1.A** (3-LS4-4); **1.LS1.B** (3-LS2-1); **2.LS2.A** (3-LS4-3),(3-LS4-4); **2.LS4.D** (3-LS4-3),(3-LS4-4); **4.ESS1.C** (3-LS4-1); **4.ESS3.B** (3-LS4-4); **4.ETS1.A** (3-LS4-4); **MS.LS2.A** (3-LS2-1),(3-LS4-1)(3-LS4-3),(3-LS4-4); **MS.LS2.C** (3-LS4-4); **MS.LS4.A** (3-LS4-1); **MS.LS4.B** (3-LS4-3); **MS.LS4.C** (3-LS4-3),(3-LS4-4); **MS.ESS1.C** (3-LS4-1),(3-LS4-3),(3-LS4-4); **MS.ESS2.B** (3-LS4-1); **MS.ESS3.C** (3-LS4-4)

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-LS2-1),(3-LS4-1),(3-LS4-3),(3-LS4-4)*
RI.3.2	Determine the main idea of a text; recount the key details and explain how they support the main idea. *(3-LS4-1),(3-LS4-3),(3LS4-4)*
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-LS2-1),(3-LS4-1),(3-LS4-3),(3-LS4-4)*
W.3.1	Write opinion pieces on topics or texts, supporting a point of view with reasons. (3-LS2-1),*(3-LS4-1),*(3-LS4-3),*(3-LS4-4)*
W.3.2	Write informative/explanatory texts to examine a topic and convey ideas and information clearly. *(3-LS4-1),(3-LS4-3),(3-LS4-4)*
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-LS4-1)
SL.3.4	Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace. *(3-LS4-3),(3-LS4-4)*

Mathematics –

MP.2	Reason abstractly and quantitatively. *(3-LS4-1),(3-LS4-3),(3-LS4-4)*
MP.4	Model with mathematics. (3-LS2-1),*(3-LS4-1),(3-LS4-3),(3-LS4-4)*
MP.5	Use appropriate tools strategically. *(3-LS4-1)*
3.NBT	Number and Operations in Base Ten (3-LS2-1)
3.MD.B.3	Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs. *(3-LS4-3)*
3.MD.B.4	Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters. *(3-LS4-1)*

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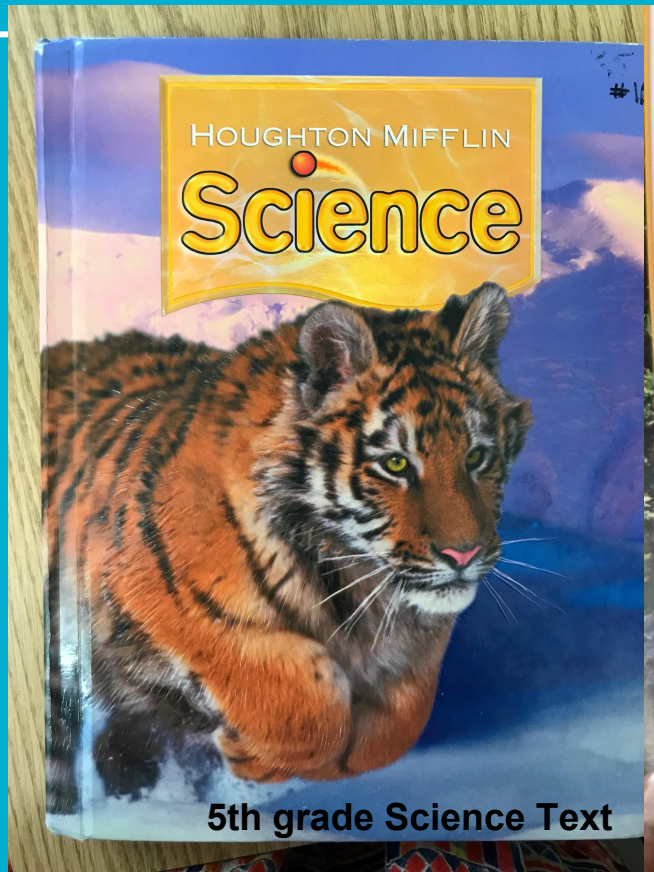
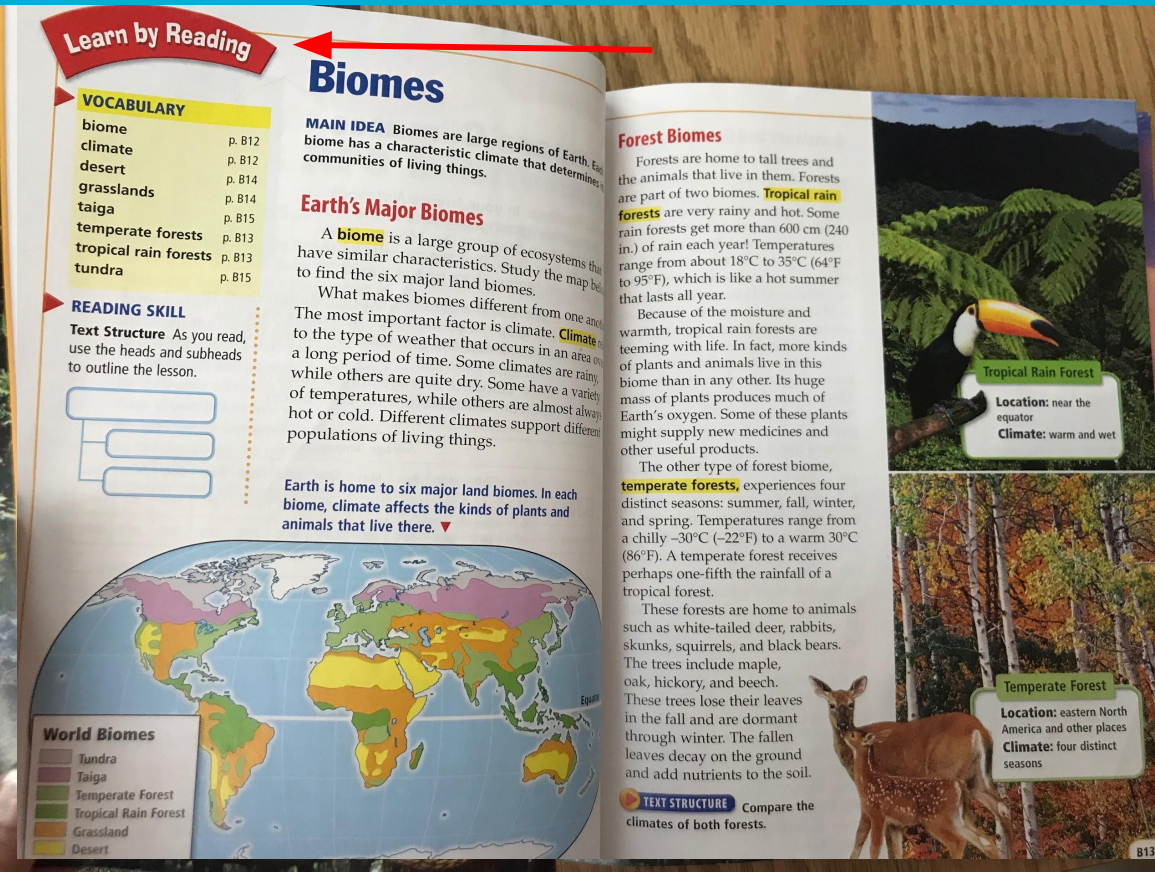
Resources to teach **Old** New Mexico Science Standards





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NGSS: Next Generation Science Standards

Inquiry Science Kits for 3rd/4th/5th grades

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From Learning to Doing

Next Generation Science Standards

Assessment?

Assessment of student knowledge of the Next Generation Science Content requires:

- Teacher Professional Development to understand the NGSS and to move the science classroom from a *Learning* mindset to a *Doing* mindset.
- Instructional Materials and Resources aligned to the standards being taught.
- Assessments aligned to the new Next Generation Science Standards.

Implementation Materials/Equipment

What Teachers need to implement the Next Generation Science Standards:

- Science Equipment
- Teacher Instructional Resources (Teacher Guides, online interactive tools, online instructional resources)
- Consumable materials (chemicals, cups, living materials, soil, etc)
- Student Resources (Informational Text, Lab/Evidence Notebooks)
- Safety Equipment (goggles, aprons, gloves, mid and high school eye wash stations, etc)

Implementation Materials & Equipment

Elementary

What this looks like for grades K-6:

- Initial Investment for Kits and Teacher Guides = approx. $134,000
- Annual cost for online subscriptions = approx. $28,000
- Annual cost to maintain Elementary Science after initial investment = approx $36,000/year
    - Includes annual online subscriptions and replacing consumable materials in kits.

Implementation Materials & Equipment

Middle School

What this looks like for grades 7 - 8:

- Initial Investment for Kits and Teacher Guides = approx. $36,000
- Annual cost for online subscriptions = approx. $28,000

Implementation Materials & Equipment

High School

What this looks like for grades 9 - 12:

- Initial cost for Vernier Probes ~ $41,000
- Periodicals ~ $3,352.08
- Consumables ~$12,000

Professional Development
Elementary

What this looks like for grades K-6:

- Initial cost for PD: Some PD comes with purchase of the kits
  - = approx. $0 - $3600/year
- Annual cost to maintain science program and to train teachers new to grade or district, including kit review for current teachers
  - = approx. $3600/year

Professional Development
Middle School

What this looks like for grades 7 -8:

- Initial cost for PD: Some PD comes with purchase of the kits
  - = approx. $0 - $3600/year
- Annual cost to maintain science program and to train teachers new to grade or district, including kit review for current teachers
  - = approx. $3600/year

Professional Development
High School

What this looks like for grades 9-12:

- Initial Cost for PD:
  - NSTA Conference ~$19,000 (one time cost)
- Annual cost to maintain science program and to train teachers new to subject or district
  - = approx. $3600/year
-

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Estimated Cost to Implement New Science Standards

	Elementary (K-6)	Middle School (7-8)	High School (9-12)
Teacher Training	$3,600/year	$6000/year	$8000/year
Materials and Kits - initial investment	$134,000	$36,000	$40,000
Maintain and resupply consumable materials, online subscriptions	$36,000/yr	$5,000/yr	$10,000/yr
Curriculum Redesign	$5,000	$10,500	$16,500
Assessment:	FY19	FY20 (text adoption)	FY21
State	$8 million	$6 million	$2 million
Local	$4 million	$3 milion	$2 million

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Doing science vs. *Learning about* science.

- The biggest Challenge is TIME!
  - Time for teachers to:
    - Learn the lessons and the science behind them
    - Gather and set up materials
    - Create and implement cross curricular connections
    - Engage in the lesson
    - Assess the lesson
- The greatest Need is CHANGE!
    - Teachers need to change their mindsets about teaching and doing science before students can change their mindsets about doing and applying science.
- The best Solution is
    - High quality and regularly scheduled professional development.
    - Time for teachers to implement these changes before they are assessed.
    - Adequate funding to support teachers and students to meet Next Generation Standards

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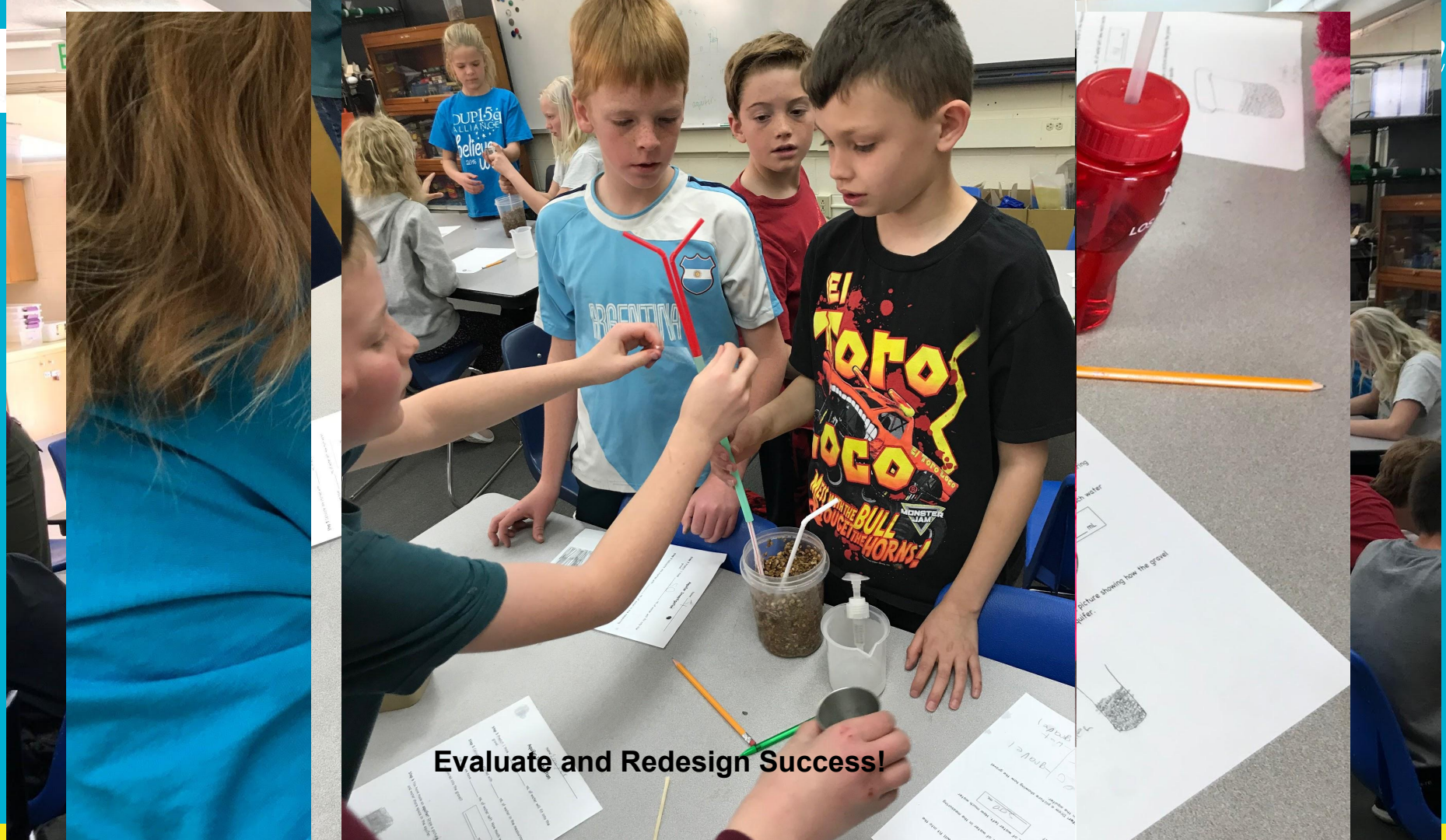
Next Gen Science In Action


Evaluate and Redesign Success!