How We Got Here

What We Did as Part of K-12 Vertical Team

- (January-March 2014) Handful of representatives at two initial meetings K-12 Science - power of that is being with powerful Science teachers who are deeply invested in the concepts. We got to see the importance of the through lines of topics, concepts, and skills. Made us want to be part of starting that off well. Using students' natural curiosity about the world but also doing our part to investigate/explore the topics.
- (January 2014) Developed Long Term Transfer Goals, Understandings and Essential Questions that were K-12.
- (January 2014)Decision was because K-5 E/LA and Math were actively being redone there was no intention of pursuing K-5 at that moment.
- (March 2014 - June 2015) Grade 6-12 unit development
- (July- August 2015) Science Grade 6-12 Curriculum proposed to BOE, Approved in August 2015
- Challenge of feeling a bit out of our element. Great to be included but also was really helpful to have K-5 conversations this year where we were able to become immersed in the standards and make sense of it in our language.
- (January - March 2014) Grades 6-12 worked on developing a new organization of Science concepts and courses. Grades 6-8 had a conversation about what potentially needed to be addressed in 5th grade. But they did that to clarify their own topics and areas of focus. This was not "telling" what 5th grade teachers needed to cover.UPDATE 2016: *No topics or units were moved down to 5th grade from a secondary level.*
- There is value in having teachers who have differing areas of expertise come together to create a cohesive curriculum. This helped us to value one another's disciplines and skillsets.

What We Did Together as a K-5 Team

- (November 2015) Drafted Long Term Transfer Goals, Understandings, and Essential Questions K-5 for Science and Engineering Practices (Blue Box)
- (December 2015 - January 2016) Drafted Understandings and Essential Questions for all of the Disciplinary Core Ideas (Orange Box).
- Worked together as a group for the entire time. We started with everyone looking at Kindergarten NGSS both for Science and Engineering Practices and for Disciplinary Core Ideas and we progressed upward through Grade 5. It was slow but also started to reveal the common through lines.
- (January 2016) John Salerni worked with Jodi to make sure it was scientifically sound as we tried to simplify language for our students. John also clarified that we don't need to go too deep on a given topic. Staying more true to the what's developmentally appropriate and being mindful of the performance expectations and assessment boundary statements included in the NGSS to guide instruction and assessment.
- (Winter 2016) Looking at inventory of current science units and cross-walking how it is connected to Next Gen Science Standards. We reached out to grade level teams that were under-represented to clarify what units and concepts they are teaching currently in each building.

- (Winter 2016) We want to honor current units, resources, and development time whenever possible but we also want to create a timeline that appreciates the need to design, acquire resources, and pilot new ideas.

Guidelines for Making Decisions on Unit Placement

- Unit standards/content must be developmentally appropriate for that grade level but also balancing that with honoring the Next Generation Science Standards (NGSS) work.
- Consider prerequisite(s) for that unit.
- Consider the timing of units in the year and the duration of them.
- Consider potential integration in ELA and Math around a common theme, skill based on application of NGSS

K-5 Science Long Term Transfer Goals APS

Science and Engineering Practices	Essential Questions	Understandings
Collaboration K-5 Work respectfully and responsibly with others to achieve a common objective.	What is my role in this investigation/design? How does it connect to the work of my peer(s)? How does working together affect the quality of results? Based on the results, what should we keep doing? What should we change?	Effective collaboration values the perspectives of others in service to a common goal. The power of collaboration has the potential to produce better results (accurate, precise, well-developed).
Planning and Carrying Out Investigations K-5 Generate questions, define problems and develop ideas/theories based on observations, experiences, curiosity, and cause and effect relationships (3+). K-5 Plan and carry out an investigation to answer a question about the world or a solution to a problem. K-5 Engage in reliable practices to collect, record, analyze, and share data. 3-5 Make qualitative observations and/or quantitative measurements to produce data to serve as a basis for evidence for an explanation of a phenomena.*	What questions do I wonder about? How can I use science to figure out the answer?	Scientists use good experimental design and laboratory techniques that lead to precise and accurate data.

Analyzing and Interpreting Data 3-5 Communicate data through a visual representation (e.g., bar graph, data table, pictograph) to reveal possible patterns that indicate relationships 3-5 Analyze and interpret data to make sense of phenomena using logical reasoning.	What patterns or trends do I see in my data? What do my results tell me? What data do I need? How much do I need? Is it good (accurate, precise, clear, addresses the question)? How do I use tools and materials to carry out my test/design my model?	Data displays (e.g., charts, tables, graphs) support and clarify explanations of evidence to increase accessibility for the intended audience. Conclusions can only be as strong as the quality and quantity of the evidence and analyses on which they are based.
Constructing Explanations and Designing Solutions K-5 Use evidence to construct an explanation *which includes the identification of variables (Gr. 3-5)* that describe and predict phenomena. K-5 Design *and compare multiple (Gr. 2-5)* solutions to a problem, based on how well they meet its criteria and constraints.	How can I use science to figure out the answer, solve a problem or design a solution? (Engineering, Gr. 3-5): What is the best model based on my criteria and constraints? (Science, Gr. 3-5) What conclusions can I draw from the patterns/trends in my data? How do I know my conclusion is valid?	Conclusions can only be as strong as the quality and quantity of the evidence, which is dependent upon a variety of factors (e.g., controlling variables, attention to precision and accuracy, replication, selection of reliable resources). There is always more than one solution to a given design problem but some are more effective than others given the criteria and constraints.
Connections to Nature of Science K-5 Identify and look for patterns, relationships, and/or order (sequence) when analyzing observations/data.	What patterns or relationships do I see in my data? What conclusions can I draw?	Scientists examine evidence to look for relationships (e.g., patterns, trends) to formulate insightful questions and solve problems.
Engaging in Argument from Evidence K-5 Based on the analysis of observations and data, construct a statement to explain a behavior or event. 3-5 Evaluate someone else's scientific explanation/solution to determine its validity/merit. (e.g., replicate someone else's results; read logic of published investigational design and results to identify problems in variables, collection tools)	How do I use my findings/solutions to show what I learned? What can I learn by sharing my work with others? (Gr. 3-5) What evidence is being used to support the scientist's statements? Is it valid? What next steps or new questions do I have?	A credible statement on a scientific issue is supported using valid evidence. Peer review helps ensure the credibility of scientific findings. Outcomes of experiments/solutions often lead to new questions/problems for further investigation.

Developing and Using Models K-5 Develop and/or use models to represent relationships or describe phenomena in the natural world.	How does this model help me to better understand a concept, answer a question, or solve a problem?	Models provide an opportunity to test predictions and ideas through simulations. There is often more than one valid approach to designing and investigating a problem.
Obtaining, Evaluating and Communicating Information K-5 Seek relevant information by locating diverse texts* on a specific topic or question. K-5 Read/view/listen to text to determine what is important in relation to a specific topic or question. K-5 Integrate prior and new knowledge to develop a deeper understanding a specific topic or question. K-5 Communicate findings, solutions or results to a specific topic or question citing specific evidence.	How can I find information to help me answer my questions? What information is important here (within and across sources)? How does what I'm reading/ seeing "fit" with what I already know? How do I share my results?	Established scientific knowledge provides the foundation for future scientific advances. Information from others helps ensure the credibility of scientific findings.
Notes: ● We have a broad definition of texts (e.g., videos, podcasts, drawings, articles, models, data table, interviews) ● Key vocabulary: constraints, criteria, phenomena (a fact, occurrence or circumstance that is observable)		

Disciplinary Core Ideas	Understandings	Essential Questions
PS1 (2,5) Grade 2: focus on solids and liquids PS1.A: Structure and Properties of Matter PS1.B: Chemical Reactions Assorted Chemical Reaction Experiments: http://bit.do/byQeV	● Everything is made up of matter (Gr. 5, even if you can't see it). ● Matter can be described and classified according to states [solid, liquid, (Gr. 5) gases] and observable properties *(e.g., color, texture, temperature, flexibility, wetness)*. ● Matter can take on a change (physical or chemical) that can be observed and measured. ● (Gr. 5) Matter is made up of small pieces/ particles that combine to make everything in the universe *(e.g., smaller parts to construct a bigger object)*	● What is this made of? ● What happens when I heat or cool this_____? Is it possible to return it to its original form? ● What is this object's purpose/function? ● How do these parts create a bigger whole? How can the whole be deconstructed (broken down) into smaller parts? ● (Gr. 5) When combined, how do substances react to make new substances? ● (Gr. 5) What happens to the weight of these substances when they are mixed and/or

http://bit.do/byQeT http://bit.do/byQfn Ideas to demonstrate how weight of substances does not change: http://bit.do/byQfw	• (Gr. 5) When a change in matter occurs, the total weight remains the same (conservation) *(e.g., weighing ice/snow in a container and later weighing the now melted ice (water) in the same container; gravel and sand; trail mix; vegetables to make salad; weighing a flashlight, then taking it apart and weighing its parts)*. • (Gr. 5) In a chemical reaction, the particles that make up the original substances can be regrouped into different substances. These new substances may have different properties than the original substances. *(e.g. burning a piece of wood/candle; turpentine on a painting; baking bread)*	react? Definition of SUBSTANCE: a pure form of matter or material with uniform properties (e.g., lemon juice; silver; helium).
PS2 (K,3,5) Ideas to demonstrate push and pull: http://bit.do/byQjR http://bit.do/byQkB Forces and Motion Gr. 3 http://www.uen.org/core/displayLessonPlans.do?courseNumber=3030&standardId=1192&objectiveId=1194 Discovery Education-District Content-Force and Motion Grade 5: gravity is formally introduced here. This is a perfect time to talk about forces opposing gravity and the concept of net force.	• Pushes and pulls (forces) cause objects to speed up, slow down, or change direction. (Gr. 3, 5) *(e.g., hitting a baseball with a bat makes it change direction and speed; bowling; dominoes)*. • Electric and magnetic fields* act as forces on objects, even when not in contact directly. *(e.g., magnetic fields moving through paper, more powerful magnets reach further, static electricity from a balloon)* **Definition of FIELD: a field is a region in which each object is affected by a force* • Objects that touch or collide push on one another and can change motion (direction and speed). • A bigger push or pull makes things speed up or slow down more quickly *(e.g., giving a big push to a friend on a swing compared to a little push, pushing a door open with a hard push compared to a light push)* • (Gr. 3, 5) The pattern of an object's motion in various situations can be observed and measured from which predictions can be made.	• What makes an object move the way it does? *(e.g., magnets, marbles)* • (Gr. 3, 5) What forces (push or pull) are acting on this object to make it move or stay still? *(e.g., tug of war, kicking a soccer ball)* • (Gr. 3, 5) How can I describe patterns of motion of object(s)? What predictions can I make from the description? *(e.g., rolling a ball on a ramp of various inclines, mini-golf, skateboarding, throwing a ball backwards or forwards)*

	• (Gr. 3, 5) An object at rest typically stays at rest unless a greater (or different) force causes it to move.	
PS3 (K,4,5) Discovery Education-District Content-Energy	• Sunlight warms Earth's surface. • Different materials are warmed differently by the sunlight. • (Gr. 4) Energy can be transferred from place to place by sound, light, heat, and electric currents ***or*** from object to object through collisions. • (Gr. 4) Objects moving quickly have more energy. *(e.g. higher speed of a bicycle or a ball that can cause greater injury/damage)* • (Gr. 4) Energy shows up in the forms of motion, sound, light, heat, and electricity. *(examples of energy are wind, sun, lightning, batteries)* • (Gr. 4) Electrical current can create motion *(spinning fan)*, sound *(music coming out a speaker)*, light *(flashlight)*, and heat *(electrical toaster oven warming a slice of bread)*. Motion, light, and heat can create electrical energy. *(e.g., sunlight creates solar power; the motion of blowing wind or flowing water can generate power)* • (Gr. 5) Energy in all animals' food can be traced back to energy from the sun.	• (K, 4, 5) How does the sun affect living and nonliving things? *(In Kindergarten, focus here is on how sun makes things warmer and how people can block sun - e.g., tent, hat, shade from an umbrella. In Gr. 5, focus on how all natural food originally came from food produced with energy from the sun.)* • (Gr. 4) What does energy look, feel, and sound like? • (Gr. 4) How can I convert energy from one form to another to solve a problem? (Use electrical energy to power a fan to cool you off, or power a light to let you read at night.)

PS4 (1,4) Discovery Education-District Content-Waves	• Sound can make matter vibrate, and vibrating matter can make sound.*(e.g. powerful speakers can make a house shake, hitting a triangle and hand vibrates; tuning fork)* • Objects can be seen if a light illuminates them or if they give off their own light. *(Gr. 4: We see objects when light reflects of their surfaces and enters our eyes.)* • Some materials allow light to pass through *(transparent)*, others block some light *(translucent)*, and others block all light and create shadows *(opaque)*. • People use light and sound to communicate. • (Gr. 4) Waves can be observed as patterns of motion and measured *(frequency, amplitude, and wavelength)* from which predictions can be made. • (Gr. 4) Digitized information (data) can be transmitted over long distances with fidelity.	• How is sound created? How does it travel? Why do some people/animals hear sounds and not others? • How does light help me see? • Why do we see shadows in some places and not in others? • (Gr. 1) How do I communicate without words or pictures? (Gr. 4) How does information travel over long distances? • (Gr. 4) How do I describe a given wave? How do I make a prediction about what will cause a change in wave characteristics? *(frequency, amplitude, wavelength)*

LS1 (K,1,3,4,5)	• All living things need food and water in order to live and grow.
	• (Gr. 1) Adults interact with their offspring to help them survive. *(e.g., mother bird gets worms for baby bird; piglet gets milk from mother)*
	• (Gr. 1, 4) Animals use parts of their bodies to survive, grow, and reproduce in their environment.
	  ○ *(Gr. 1): see; hear; hold objects; protect themselves; move; and find food, water, and air.*
	  ○ *(Gr 4): grow, survive, behave/interact, reproduce.*
	• (Gr. 1, 4) Plants have different parts *(roots, stems, leaves, flowers, fruits)* that help them to survive, grow, and reproduce.
	• (Gr. 3) Plants and animals have unique and diverse life cycles, but reproduction is necessary for all species to survive.
		• What does this living thing eat to grow?
		• How is the same organism alike or different? (*e.g. parent/child, chihuahua/great dane*)?
		• How do adult animals help their young survive?
		• How do parts of this organism help it grow and survive?
		• How do life cycles of [these] organisms compare to one another? *(can use to focus on birth, growth, reproduction, typical life span)*
		• (Gr. 4) How do organisms use their senses to help them survive?

	• (Gr. 4) Animals rely on their senses and memories to guide their actions.	
LS2 (2,3,5)	• (Gr. 2) Plants depend on water and light to grow. • (Gr. 2) Plants are dependent on animals for pollination or to move their seeds around. • (Gr. 3) Based on the hospitality of an ecosystem, some organisms adapt and survive, some move to new locations and survive, and some die. • (Gr. 3) Living in groups helps many animals to survive. *(finding food, protection)*. • (Gr. 5) The food of almost any animal can be traced back to plants. • (Grd. 5) A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life.	• How do plants and animals depend on their environment (sun and water) to survive and grow? • (Gr. 3) How can forming a group help an animal survive? • (Gr. 3, 5) How does an animal/organism/species' response to its ecosystem affect the chances that it will survive? • (Gr. 3, 5) How will an animal/organism's ability to respond to its environment affect its survival?
LS3 (1,3)	• Organisms inherit some characteristics from their parents and develop others as a result of their interactions with the environment. • (Gr. 3) Organisms have different traits that affect how they look and function and which impact their survival.	• What does an offspring inherit from their parents? *(Add this next question for Gr. 3)* What does the offspring get from their environment? • How do some organisms develop characteristics based on interactions with their environment?
LS4 (2,3)	• (Gr. 2, 3) Based on the hospitality of an ecosystem/habitat, some organisms adapt and survive, some move to new locations and survive, and some die. • (Gr. 3) Organisms have different traits that affect how they look and function which impact their survival. • (Gr. 3) Fossils provide evidence about the types of extinct organisms that lived long ago and also about the nature of their environments.	• (Gr. 2) How does a habitat support the plants and animals that live there? • (Gr. 3) How does the [animal or plant name]'s [trait] help it to survive in the world? • (Gr. 3) Why do some living things no longer exist on Earth? How are they different from living things on Earth today?
Disciplinary Core Ideas	**Understandings**	**Essential Questions**
ESS1 (1,2,4,5)	• *(Gr. 1) The relationship between the time of*	• (Gr. 1) How much daylight is there today?

	year/season and the amount of daylight can be observed, described, and predicted. • (Gr. 1+) Patterns of the (apparent) motion of the sun, moon, and stars in the sky can be observed, described, predicted, and explained. (4+) The movements of the sun, Earth and moon cause observable and predictable patterns, such as seasons, eclipses, sunrises/sunsets. • The sun is a star that appears larger and brighter because it's closer. Stars range greatly in their distance from Earth. • Earth events can occur quickly; others occur very slowly, sometimes over a time period much longer than one can observe. • (4, 5) The study of rocks, fossil records, tectonic processes help us to organize, understand, and interpret the formation and geological history and timescale of Earth. (In Grades 4-5, we talk about layers of rock and their position show when fossils were buried, paths cut in rock can indicate the former presence of a river that caused erosion.)	How does that compare to last ____ (month, season)? • (Gr. 1-3) What objects (celestial objects such as moon, stars) do we see in the sky? How are they the same every day? How are they different? (Gr. 4+) What are the predictable patterns caused by Earth's movement in the solar system?(e.g., shadows, brightness due to relative distance, seasonal appearance of stars) • (2-5) How does Earth change quickly and slowly? (volcanic explosions,earthquakes, erosion) • (2-5) How does land change? What causes the land to change?
ESS2 (K,2,3,4,5)	• (K-5) Weather may change from season to season or from day to day but the climate is largely predictable. (e.g., in New England our climate consists of hot,humid summers and frigid, snowy winters, whereas in a tropical rainforest the climate consists of hot humid weather with dry or rainy seasons). • (K+) All living things can change the environment to meet their needs (e.g., squirrels burying nuts for the winter, farming the land, tree roots breaking concrete.) • (2-12) Wind, water, ice, gravity, and living organisms can change the shape of the land. • (Gr. 2+)Water can take different forms on Earth (liquid=oceans, rivers, lakes, and pond, in the soil, in plants and animals, solid=ice, snow) • (2-3) Maps can show where land and water are	• (K-5) What combination of factors create weather? (factors could include sunlight, wind, clouds, snow, or rain, and temperature in a particular region at a particular time) • (K+) How do we describe weather to notice patterns over time? • (K+) How do living things make the environment "just right" for them? • (2-5) What causes the land to change? (focus here on wind and water in Grade 2) • (Gr. 2-5) How do maps help me understand the Earth? • (Gr. 2-5) Where do I see water in my environment? Where else can it be found? How does it support life on Earth? (Gr. 5 focus on fresh water and salt water) • (K-2) How does looking at the weather help

	located. ● (4+) The study of rocks, fossil records, tectonic processes helps us to organize, understand, and interpret the formation and geological history and timescale of Earth. (In Grades 4-5, we talk about layers of rock and their position show when fossils were buried, paths cut in rock can indicate the former presence of a river that caused erosion.) ● (5+) Earth's major systems interact in multiple ways to affect Earth's surface materials and processes. ● (5+) The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate.	me make decisions? (Gr. 3+) How does the study of weather and climate influence human behavior? ● (K-5) How does looking at patterns of weather determine the climate of a region? ● (Gr. 2+) How do scientists observe, record, study and predict changes in the Earth? ● (K+) How do people prepare for severe weather?
ESS3 (K,3,4,5)	● (K-5) Things that people do to live comfortably affect the world around them, but they can make choices that reduce their impacts on the Earth and other living things. ● (Gr. 3+) Humans cannot eliminate natural hazards but can take steps to reduce their impacts. ● (K-5) Human activity impacts many of Earth's systems. ● (K-5) Human sustainability is dependent upon the responsible management of natural resources. ● (4+) All forms of energy production and other resource extraction (through new technologies) have economic. social, environmental, and geopolitical costs that must be considered to determine viable courses of action.	● (K-5) How do people's actions impact the world around them? (can be negative or positive. e.g., negative = commuting to work, bears in town because we took away habitat; positive = turning off water when you brush your teeth, starting a recycling program at school) ● (Gr. 4+) How do we use resources to "fuel"/power the world? What are the advantages and disadvantages of each resource? (Focus on renewable and non-renewable resources)
K-2-ETS1	● (K-5) Engineers learn from failure. Failure helps engineers learn more about how things work and how they can improve upon their design. ● (K-2) There is often more than one possible solution to a problem, but some are more effective, more elegant (aesthetically pleasing)	● (K-5)What problem do I want to solve? How do I design a model/drawing to create a solution? How do I test it out and continue to make it better? (Engineering practice includes: asking questions, making observations, gathering information)

	in design, more appropriate/useful to the audience, more replicable to produce.	
3-5-ETS1	• (K-5) Engineers learn from failure. Failure helps engineers learn more about how things work and how they can improve upon their design. (Building and testing with physical models, under a variety of conditions, is the most effective way to identify unexpected failure points in a proposed solution.) • (Gr. 3-5) Engineers respond to a need by understanding the problem and developing solution(s) within given constraints and criteria. • (Gr. 3-5) There is often more than one possible solution to a problem, but some are more effective than others given the criteria and constraints.	• (K-5) What problem do I want to solve? How do I design a model/drawing to create a solution? How do I test it out and continue to make it better? (Engineering practice includes: asking questions, making observations, gathering information) • (Gr. 3-5) What can I learn from my experience?