Updates to K-2 Science

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About the Presenter

- Started with BTSD in July 2016
- Previously:
  - Supervisor of Math, Science, World Language, Business and Technology & District Anti-Bullying Coordinator
    - Clark Public Schools 2013-2016
  - High School Science Teacher
    - Chemistry, Physics, Geophysical Science (aka Earth Science) & Environmental Science
    - Hillsborough Public Schools 2005-2013
- Lives with wife, Teresa, sons Aiden (7) and Aaron (4)
  - And Baby #3 eta Valentine's Day 2018

Why Change the Science Curriculum?

It’s a Long (but good) Story

Early 2000
AAAS: Early childhood learning progressions are mapped

2010
Development of Next Generation Science Standards (NGSS) enters public review

2012
Framework for K-12 Science Education released by National Research Council

Continuing down a long path

April 2013 After multiple revisions, the NGSS are completed

July 2013 NJ adopts the NGSS to replace the 2009 NJ CCCS*

2016 NJ DOE takes the NGSS and reorganizes them into the NJ SLS for Science

*Grades 6-12 are given until Sept. 2016 to revise curricula and implement the NGSS
Grades K-5 are given until Sept. 2017 to revise curricula and implement the NGSS

The NGSS and the SLS for Science are the Same!

NGSS

Students who demonstrate understanding can:

K-PS3-1. **Make observations to determine the effect of sunlight on Earth's surface.** [Clarification Statement: Examples of Earth's surface could include sand, soil, rocks, and water.] [*Assessment Boundary: Assessment of temperature is limited to relative measures such as warmer/cooler.*]

K-PS3-2. **Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.*** [Clarification Statement: Examples of structures could include umbrellas, canopies, and tents that minimize the warming effect of the sun.]

K-ESS2-1. **Use and share observations of local weather conditions to describe patterns over time.** [Clarification Statement: Examples of qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm); examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months.] [*Assessment Boundary: Assessment of quantitative observations limited to whole numbers and relative measures such as warmer/cooler.*]

K-ESS3-2. **Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.*** [Clarification Statement: Emphasis is on local forms of severe weather.]

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	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in grades K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. • Ask questions based on observations to find more information about the designed world. (K-ESS3-2) **Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. • Make observations (firsthand or from media) to collect data that can be used to make comparisons. (K-PS3-1) **Analyzing and Interpreting Data** Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. (K-ESS2-1)	**PS3.B: Conservation of Energy and Energy Transfer** • Sunlight warms Earth's surface. (K-PS3-1),(K-PS3-2) **ESS2.D: Weather and Climate** • Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time. (K-ESS2-1) **ESS3.B: Natural Hazards** • Some kinds of severe weather are more likely than others in a given region. Weather scientists forecast severe weather so that the communities can prepare for and respond to these events. (K-ESS3-2) **ETS1.A: Defining and Delimiting an Engineering Problem** • Asking questions, making observations, and gathering information are helpful in thinking about problems. *(secondary to K-ESS3-2)*	**Patterns** • Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. (K-ESS2-1) **Cause and Effect** • Events have causes that generate observable patterns. (K-PS3-1),(K-PS3-2),(K-ESS3-2) - ***Connections to Engineering, Technology, a nd Applications of Science*** **Interdependence of Science, Engineering, and Technology** • People encounter questions about the natural world every day. (K-ESS3-2) **Influence of Engineering, Technology, and Science on Society and the Natural World** • People depend on various technologies in their lives; human life would be very different without technology. (K-ESS3-2)

NJ SLS Science

New Jersey Student Learning Standards SCIENCE

K-PS3 Energy

K-PS3 Energy

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Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. • Make observations (firsthand or from media) to collect data that can be used to make comparisons. (K-PS3-1) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. • Use tools and materials provided to design and build a device that solves a specific problem or a solution to a specific problem. (K-PS3-2) - ***Connections to Nature of Science*** **Scientific Investigations Use a Variety of Methods** • Scientists use different ways to study the world. (K-PS3-1)	**PS3.B: Conservation of Energy and Energy Transfer** • Sunlight warms Earth's surface. (K-PS3-1),(K-PS3-2)	**Cause and Effect** • Events have causes that generate observable patterns. (K-PS3-1),(K-PS3-2)

Connections to other DCIs in kindergarten: **K.ETS1.A** (K-PS3-2); **K.ETS1.B** (K-PS3-2)

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

ELA/Literacy –

W.K.7 Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them). (K-PS3-1),*(K-PS3-2)*

Mathematics –

K.MD.A.2 Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference. (K-PS3-1),(K-PS3-2)

Why are the NGSS *(and by default, the NJ SLS for Science)* so Great?

There are few important things to point out

#1
The Standards are Specific to the Grade K-5

KINDERGARTEN	FIRST GRADE	SECOND GRADE
K-PS2 Motion and Stability: Forces and Interactions	1-PS4 Waves and Their Applications in Technologies for Information Transfer	2-PS1 Matter and Its Interactions
K-PS3 Energy	1-LS1 From Molecules to Organisms: Structures and Processes	2-LS2 Ecosystems: Interactions, Energy, and Dynamics
K-LS1 From Molecules to Organisms: Structures and Processes	1-LS3 Heredity: Inheritance and Variation of Traits	2-LS4 Biological Evolution: Unity and Diversity
K-ESS2 Earth's Systems	1-ESS1 Earth's Place in the Universe	2-ESS1 Earth's Place in the Universe
K-ESS3 Earth and Human Activity	K-2-ETS1 Engineering Design	2-ESS2 Earth's Systems
K-2-ETS1 Engineering Design		K-2-ETS1 Engineering Design
THIRD GRADE	**FOURTH GRADE**	**FIFTH GRADE**
3-PS2 Motion and Stability: Forces and Interactions	4-PS3 Energy	5-PS1 Matter and Its Interactions
3-LS1 From Molecules to Organisms: Structures and Processes	4-PS4 Waves and Their Applications in Technologies for Information Transfer	5-PS2 Motion and Stability: Forces and Interactions
3-LS2 Ecosystems: Interactions, Energy, and Dynamics	4-LS1 From Molecules to Organisms: Structures and Processes	5-PS3 Energy
3-LS3 Heredity: Inheritance and Variation of Traits	4-ESS1 Earth's Place in the Universe	5-LS1 From Molecules to Organisms: Structures and Processes
3-LS4 Biological Evolution: Unity and Diversity	4-ESS2 Earth's Systems	5-LS2 Ecosystems: Interactions, Energy, and Dynamics
3-ESS2 Earth's Systems	4-ESS3 Earth and Human Activity	5-ESS1 Earth's Place in the Universe
3-ESS3 Earth and Human Activity	3-5-ETS1 Engineering Design	5-ESS2 Earth's Systems
3-5-ETS1 Engineering Design		5-ESS3 Earth and Human Activity
		3-5-ETS1 Engineering Design

#2
Take a closer look- the topics “spiral” or repeat themselves so that as students get older they revisit concepts to build upon prior knowledge

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K-PS2 Motion and Stability: Forces and Interactions	1-PS4 Waves and Their Applications in Technologies for Information Transfer	2-PS1 Matter and Its Interactions
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K-LS1 From Molecules to Organisms: Structures and Processes	1-LS3 Heredity: Inheritance and Variation of Traits	2-LS4 Biological Evolution: Unity and Diversity
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3-LS2 Ecosystems: Interactions, Energy, and Dynamics	4-LS1 From Molecules to Organisms: Structures and Processes	5-PS3 Energy
3-LS3 Heredity: Inheritance and Variation of Traits	4-ESS1 Earth's Place in the Universe	5-LS1 From Molecules to Organisms: Structures and Processes
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3-ESS3 Earth and Human Activity	3-5-ETS1 Engineering Design	5-ESS2 Earth's Systems
3-5-ETS1 Engineering Design		5-ESS3 Earth and Human Activity
		3-5-ETS1 Engineering Design

Grades 6-8		
Earth and Space Sciences	**Life Sciences**	**Physical Sciences**
MS-ESS1 Earth's Place in the Universe	MS -LS1 From Molecules to Organisms: Structures and Processes	MS-PS1 Matter and its Interactions
MS-ESS2 Earth's Systems	MS -LS2 Ecosystems: Interactions, Energy, and Dynamics	MS-PS2 Motion and Stability: Forces and Interactions
MS -ESS3 Earth and Human Activity	MS -LS3 Heredity: Inheritance and Variation of Traits	MS-PS3 Energy
	MS -LS4 Biological Evolution: Unity and Diversity	MS-PS4 Waves and their Applications in Technologies for Information Transfer
MS-ETS1 Engineering Design		
Grades 9-12		
Earth and Space Sciences	**Life Sciences**	**Physical Sciences**
HS-ESS1 Earth's Place in the Universe	HS-LS1 From Molecules to Organisms: Structures and Processes	HS-PS1 Matter and its Interactions
HS-ESS2 Earth's Systems	HS-LS2 Ecosystems: Interactions, Energy, and Dynamics	HS-PS2 Motion and Stability: Forces and Interactions
HS -ESS3 Earth and Human Activity	HS -LS3 Heredity: Inheritance and Variation of Traits	HS-PS3 Energy
	HS-LS4 Biological Evolution: Unity and Diversity	HS-PS4 Waves and their Applications in Technologies for Information Transfer
HS-ETS1 Engineering Design		

This overlap continues into grades 6-12

#3
Verbiage is “student focused

K-PS2 Motion and Stability: Forces and interactions
Students who demonstrate understanding can:
K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. [Clarification Statement: Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other.] [Assessment Boundary: Assessment is limited to different relative strengths or different directions, but not both at the same time. Assessment does not include non-contact pushes or pulls such as those produced by magnets.]
K-PS2-2. Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.* [Clarification Statement: Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, and knock down other objects. Examples of solutions could include tools such as a ramp to increase the speed of the object and a structure that would cause an object such as a marble or ball to turn.] [Assessment Boundary: Assessment does not include friction as a mechanism for change in speed.]
The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

- Science isn’t about learning new vocabulary or memorizing fact
- Starting in Kindergarten, students analyze scenarios and apply existing knowledge to new situations to draw informed conclusions

#4
Standards also clarify expectation boundaries

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

#5
The Three Components of Science Instruction

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. ▪ With guidance, plan and conduct an investigation in collaboration with peers. (K-PS2-1) **Analyzing and Interpreting Data** Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. ▪ Analyze data from tests of an object or tool to determine if it works as intended. (K-PS2-2) ---------- ***Connections to Nature of Science*** **Scientific Investigations Use a Variety of Methods** ▪ Scientists use different ways to study the world. (K-PS2-1)	**PS2.A: Forces and Motion** ▪ Pushes and pulls can have different strengths and directions. (K-PS2-1),(K-PS2-2) ▪ Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. (K-PS2-1),(K-PS2-2) **PS2.B: Types of Interactions** ▪ When objects touch or collide, they push on one another and can change motion. (K-PS2-1) **PS3.C: Relationship Between Energy and Forces** ▪ A bigger push or pull makes things speed up or slow down more quickly. *(secondary to K-PS2-1)* **ETS1.A: Defining Engineering Problems** ▪ A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions. *(secondary to K-PS2-2)*	**Cause and Effect** ▪ Simple tests can be designed to gather evidence to support or refute student ideas about causes. (K-PS2-1),(K-PS2-2)

- Science & Engineering Practices- types of activities students are doing while addressing the standards
- Disciplinary Core Ideas (DCIs)- The focal points that students should attain mastery of following instruction
- Crosscutting Concepts- how this standard links to other science topics

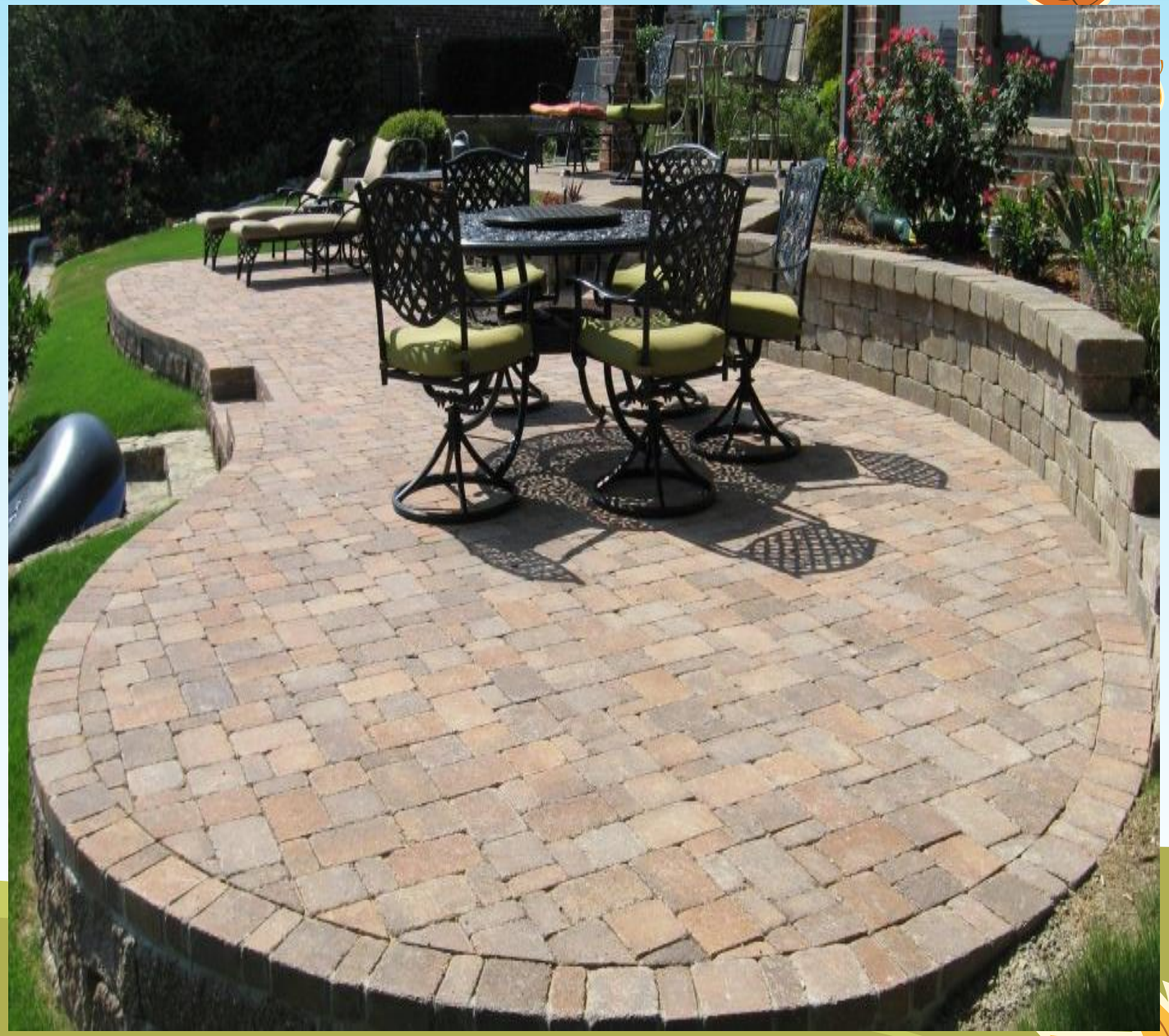
In Summary

- Never before have science standards:
  - Provided deliberate overlap to build upon prior learning
  - Been so focused upon what the students are doing when addressing the standards

Let’s Explore the New Approach

I have a problem: On a sunny summer day, by the middle of the morning it is too hot to sit comfortably on my patio and the warm bricks hurt my bare feet.

Please turn to a neighbor and discuss what I could do to address my problem



*This is not my real patio

This is Artificial

- In a real class we would share out some ideas
- Realistically- I need to set some constraints
- The teacher would guide this discussion as the students provide the constraints
  - I need to be able to use my patio now
  - Not going outside is not a solution to the problem- I need to be able to use my patio
  - My solution can't cause damage to my house or patio
  - Etc.
- After ample input from students….

Our Rubric

Parameters	1 Point	2 Points	3 Points
Proposal Blocks the Sun	Only for a portion of the day/will have limited success changing the temperature	All day long in a manner that keeps the sitting area cool but fails to address the ground	All day long in a manner that keeps the seating area and ground beneath cool all day
Proposal can withstand weather/the seasons	Does not come down readily/cannot withstand the seasons	Comes down very easily in response to changing weather/seasons	Very durable and can weather all seasons
Aesthetically appearing/does not significantly alter the back yard	Requires significant changes to the current layout of the yard/decor	Will have minimal impact/slight mismatch existing decor	Will have no impact/match existing decor
Added Benefit: proposal blocks rain too	Guests will get wet if there is any rain	Guests may get wet if there is wind-blown rain	Guests seated underneath will not get wet during rain

What would happen next?

- In groups, students would review the rubric and design a solution to the problem
- Each group would present back to the class with peers scoring based upon this rubric
  - This isn't being "graded"
  - Students are collaborating and providing feedback in a safe, risk-free environment
  - *Take a moment on how this is a reflection of the real/professional world*
- Collectively, the class would reach a conclusion on which solution or combination of solutions best addresses the problem
  - No right or wrong answer- just a better collective understanding of the natural world around us

K-PS3-2
Kindergarten- Physical Science #3-2

- Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area
- Another iteration of this problem:
  - The playground is too hot to use on a sunny day

So what do new science lessons look like?

Structure of an Aligned Lesson

- It starts with a Phenomena
  - A phenomena queues the lesson. It can be:
    - A picture
    - A reading passage
    - A demonstration (in class or video)
    - An activity where students make observations/collect data
- The Phenomena can be:
  - Used to introduce the unit and revisited throughout the entire unit
  - Unique to a lesson and not (really) revisited beyond that lesson

Structure of an aligned lesson (continued)

- Phenomena
- Discussion that produces parameters for investigation of the phenomena
  - By guiding this discussion we can lead students to point out criteria we have already considered and included on a pre-existing rubric
- Carry out activities to investigate/explore the phenomena in response to the criteria and rubric
- Students to receive ample feedback in “safe” setting (nothing scored/graded)
- At end of unit, a graded activity will be used for reporting progress on the report card
  - This activity will be similar/familiar, but not identical to, the “safe” explorations of the phenomena

Hold on- Elaborate on those Scored Assessments

What does familiar but not identical mean?

I Will Use Grade 1 as an Example

- No part of our curriculum uses Multiple Choice Tests
  - No fact memorization- application in analytical lab settings
- Throughout the course of a unit on Heredity of Traits, 1st grade students study the developmental life cycles of:
  - Humans
  - Chickens
  - Butterflies
  - Frogs
  - Ants
  - Caterpillars

All that work in a “safe” setting- one graded assessment question:

Scenario #2: You are the first explorer of a new planet and you discover an entirely new species of animal. Applying your knowledge about the life cycles of living things, please draw a detailed description of this new animal. Your diagram must include:

- The name of your new animal
- Two (2) parent animals
- At least three (3) animal children
- Distinct features about this animal. You do not have to include all of the examples below- these are just to give you an idea.

Body Covering Examples	Body Feature Examples	Color Options	Head & Face Features
Skin Fur Feathers Scales	Tails Wings Arms Legs Hands Feet Claws	Solid Color Stripes Spots Camouflage	Eyes Nose Mouth Teeth Ears Horns Hair

Please use the space below to complete your diagram.

So What Are Students Learning?

Kindergarten

- Sensational Senses
- Weather, Sunlight & Energy
- Motion & Forces
- Living Things

First Grade

- Parents & Heredity: Inspired by Nature
- Light & Sounds
- Earth’s Patterns
- Measurement

Second Grade

- Matter & Materials
- Ecosystems
- Measurement
- Fast & Slow Changes

Third Grade

- Forces & Interactions
- Life Cycles & Traits
- Weather & Climate

Fourth Grade

- Energy
- Structure & Function
- Earth’s Surface Processes
- Waves

Fifth Grade

- Structure, Properties & Interactions of Matter
- Matter & Energy in Organisms & Ecosystems
- Earth Surface Processes
- Space Systems: Stars & The Solar System

How are we delivering the program?

Overview

- Backbone of the program: Knowing Science
  - K-5 teachers have had 2.5 hours of training per grade this year
  - An additional session is taking place this afternoon
  - Program includes kits of lab materials and literacy bundles
- “Off the Shelf” is not good enough for us
  - Master teachers have the flexibility to develop their own phenomena and introduce the content in ways that best enable them to use their passion, experience, and expertise to address the needs of their students
- Supplementing with additional resources
  - Additional lab materials to reduce group size/increase student engagement
  - Supporting resources for teachers and students

Thank You

Questions?

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