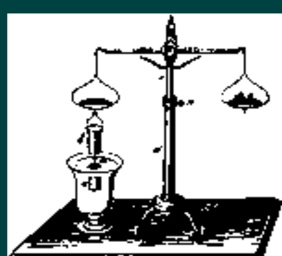
Science Project Team Report

Phase 2

2020



BEAVERTON
SCHOOL DISTRICT

Science Project Team
Phase 2 Report 2020
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BEAVERTON SCHOOL DISTRICT

March, 2020

In April of 2018, the Beaverton School District Board charged the Science Project Team with the task of evaluating and making specific programmatic recommendations for the District. The science curriculum review, as outlined in Board policy and administrative regulation for the Quality Curriculum Cycle, includes learning targets, instructional practices, assessment, instructional resources and professional development.

Within the review process, the Science Project Team studied science education in the context of today's world. The focus on and demand for higher levels of science education is evident in the Next Generation Science Standards (NGSS) as well as within the skill set deemed essential for college and career readiness and success. The Beaverton School District's goal is to prepare students to engage in the world as critical thinkers and culturally competent citizens; this requires that all students receive a strong Science education

As a result, the Science Project Team defined a comprehensive set of Phase 1 recommendations:

- Science Instruction Position Paper
- Best Practices in Science
- Physics / Chemistry / Biology Learning Targets
- High School Professional Development Plan
- Instructional Resources Recommendation

The School Board approved the Phase I report at the May 2019 meeting.

Phase 2 work of the Science Project Team includes recommendations for K-8 Learning Targets, K-8 Instructional Resources, and a K-8 Professional Development plan.

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WE EXPECT EXCELLENCE WE INNOVATE WE EMBRACE EQUITY WE COLLABORATE

District Goal
WE empower all students to achieve post-high school success.

Science Learning Targets – Kindergarten 2020

All classroom instruction and assessments are aligned to BSD Learning Targets

ALT - Academic Learning Target **AST** - Academic Supporting Target

ALT1: Scientific Practices: Explains scientific phenomena using the practices of science through investigation, modeling, argumentation, and use of information.

AST 1.1: Asking Questions - With guidance, asks questions based on observations to find more information about the natural and human-made world.

AST 1.2: Developing and Using Models - With guidance, identifies, uses, and develops models that represent concrete events. Distinguishes between a model and the actual phenomenon.

AST 1.3: Planning and Conducting Investigations - With guidance, collects and shares data from an investigation with peers.

AST 1.4: Analyzing and Interpreting Data - With guidance, collects and shares data from an investigation with peers and compares predictions to what occurred.

AST 1.5: Mathematical and Computational Thinking - With guidance, uses counting and numbers to identify and describe patterns in the natural world. Uses and compares quantitative data.

AST 1.6: Constructing Explanations - With guidance, uses information from observations to identify and describe patterns in the natural world.

AST 1.7: Engaging in Argument from Evidence- With guidance, listens actively to others' explanations and arguments and asks questions for clarification.

AST 1.8: Obtaining, Evaluating, and Communicating Information - With guidance, reads grade-appropriate texts and uses media to obtain scientific and technical information. Communicates information.

ALT 2: Engineering: Shares ideas about a simple defined problem, plans a possible solution, builds it with suggested materials, and considers whether the design met criteria.

AST 2.1 - Asks questions and makes observations about a situation people want to change to identify a simple problem that can be solved through the development of a new or improved object or tool.(ETS1-1)

AST 2.2 - Develops a simple drawing, or physical model to solve a given problem. (ETS1-2) AST 2.3 - Compares the strengths and weaknesses of the design of two objects that solve the same problem. (ETS1-3)

AST 2.3 - Compares the strengths and weaknesses of the design of two objects that solve the same problem. (ETS1-3)

ALT3: Life Science: Uses observations to describe patterns of what plants and animals (including humans) need to survive.

AST 3.1 - Uses observations to describe patterns of what plants and animals (including humans) need to survive. (K-LS1-1)

ALT4: Earth Science: Describes variations in weather and other environmental conditions to explain where, how, and why plants and animals live in and change places.

AST 4.1 - Uses and shares observations of local weather conditions to describe patterns over time. (K-ESS2-1)

AST 4.2 - Constructs an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs. (K-ESS2-2)

AST 4.3 - Uses a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live. (K-ESS3-1)

AST 4.4 - Asks questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather. (KESS3-2)

AST 4.5 - Communicates solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment. (K-ESS3-3)

ALT5: Physical Science: Investigates physical science concepts, including pushes and pulls and the effects of sunlight on Earth's surface.

AST 5.1 - Plans and conducts an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. (K-PS2-1)

AST 5.2 - Analyzes 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. (K-PS2-2)

AST 5.3 - Makes observations to determine the effect of sunlight on Earth's surface. (K-PS3-1)

AST 5.4 - Uses tools and materials provided to design and build a structure that will reduce the warming effect of sunlight on Earth's surface. (K-PS3-2)

Science Learning Targets – 1st Grade 2020

All classroom instruction and assessments are aligned to BSD Learning Targets

ALT - Academic Learning Target **AST** - Academic Supporting Target

ALT1: Scientific Practices: Explains scientific phenomena using the practices of science through investigation, modeling, argumentation, and use of information.

AST 1.1: Asking Questions - With guidance, asks questions based on observations to find more information about the natural and human-made world.
AST 1.2: Developing and Using Models - With guidance, identifies, uses, and develops models that represent concrete events. Distinguishes between a model and the actual phenomenon.
AST 1.3: Planning and Conducting Investigations - With guidance, collects and shares data from an investigation with peers.
AST 1.4: Analyzing and Interpreting Data - With guidance, collects and shares data from an investigation with peers and compares predictions to what occurred.
AST 1.5: Mathematical and Computational Thinking - With guidance, uses counting and numbers to identify and describe patterns in the natural world. Uses and compares quantitative data.
AST 1.6: Constructing Explanations - With guidance, uses information from observations to identify and describe patterns in the natural world.
AST 1.7: Engaging in Argument from Evidence- With guidance, listens actively to others' explanations and arguments and asks questions for clarification.
AST 1.8: Obtaining, Evaluating, and Communicating Information - With guidance, reads grade-appropriate texts and uses media to obtain scientific and technical information. Communicates information.

ALT 2: Engineering: Shares ideas about a simple defined problem, plans a possible solution, builds it with suggested materials, and considers whether the design met criteria.

AST 2.1 - Asks questions and makes observations about a situation people want to change to identify a simple problem that can be solved through the development of a new or improved object or tool.(ETS1-1)
AST 2.2 - Develops a simple drawing, or physical model to solve a given problem. (ETS1-2)
AST 2.3 - Compares the strengths and weaknesses of the design of two objects that solve the same problem. (ETS1-3)

ALT3: Life Science: Observes and gives evidence of how plants and animals use their external parts, inherited traits and behaviors to help them survive, grow and meet their needs.

AST 3.1 - Uses materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs (1-LS1-1)
AST 3.2 - Reads texts and uses media to determine patterns in behavior of parents and offspring that help offspring survive. (1-LS1-2)
AST 3.3 - Makes observations to construct an evidence - based account that young plants and animals are like, but not exactly like, their parents. (1-LS3-1)

ALT4: Earth Science: Collects and analyzes data to describe and predict patterns in the movements of objects in the sky.

AST 4.1 - Uses observations of the sun, moon, and stars to describe patterns that can be predicted. (1-ESS1-1)
AST 4.2 - Makes observations at different times of year to relate the amount of daylight to the time of year. (1-ESS1-2)

ALT5: Physical Science: Investigates and explains how light and sound travel, the connection between sound and vibrating materials, and the relationship between the presence of light and the ability to see objects.

AST 5.1 - Plans and conducts investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. (1-PS4-1)

AST 5.2 - Uses tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance. (1-PS4-4)
AST 5.3 - Plans and conducts investigations to determine the effect of placing objects made with different materials in the path of a beam of light. (1-PS4-3)
AST 5.4 - Makes observations to construct an evidence - based account that objects in darkness can be seen only when illuminated. (1-PS4-2)

Science Learning Targets – 2nd Grade 2020

All classroom instruction and assessments are aligned to BSD Learning Targets

ALT - Academic Learning Target **AST** - Academic Supporting Target

ALT1: Scientific Practices: Explains scientific phenomena using the practices of science through investigation, modeling, argumentation, and use of information..

AST 1.1: Asking Questions - Asks and/or identifies questions that can be answered by an investigation.
AST 1.2: Developing and Using Models - Identifies, uses, and develops models that represent patterns, scale, and/or relationships of concrete events. Compares between a model, the actual phenomenon, and other models.
AST 1.3: Planning and Carrying Out Investigations - Plans and conducts an investigation to produce data that can be used as evidence to answer a question.
AST 1.4: Analyzing and Interpreting Data - Collects and shares data from an investigation with peers and compares predictions to what occurred.
AST 1.5: Mathematical and Computational Thinking - Uses numbers to identify and describe patterns in the natural world. Decides when to use qualitative versus quantitative data and creates graphs appropriately.
AST 1.6: Constructing Explanations - Constructs a claim and supports it with evidence to explain a phenomenon and share it with peers.
AST 1.7: Engaging in Argument From Evidence - Identifies arguments that are supported by evidence, listens actively to others' explanations and arguments and ask questions for clarification, and distinguishes between opinion and evidence.
AST 1.8: Obtaining, Evaluating and Communicating Information - Reads and comprehends grade-appropriate texts and media to acquire scientific information. Uses text features to obtain and explain information. Critiques and communicates information with others in varied oral and written forms.

ALT 2: Engineering: Defines a simple problem that can be solved through the development of a new or improved object or tool then designs and builds the object or tool and evaluates how it worked to solve the problem.

AST 2.1 - Asks questions, makes observations, and gathers information about a situation people want to change to define a simple problem with criteria that can be solved through the development of a new or improved object or tool.(K-2 ETS1-1)
AST 2.2 - Develops a detailed drawing or physical model to show how the form of an object helps it function as needed to solve a given problem that could meet the criteria. (K-2 ETS1-2)
AST 2.3 - Analyzes the strengths and weaknesses based on data from tests of two objects designed to solve the same problem and suggest improvements. (K-2 ETS1-3)

ALT3: Life Science: Compare and investigate the diversity of life as well as how plants grow and reproduce.

AST 3.1 - Plans and conducts an investigation to determine if plants need sunlight and water to grow. (LS2-1)
AST 3.2 - Develops a simple model that mimics the function of an animal in dispersing seeds or pollinating plants (LS2-2.)
AST 3.3 - Makes observations of plants and animals to compare the diversity of life in different habitats. (2-LS4-1)

ALT4: Earth Science: Use information and models to show how and where the shapes of land and water can change on earth.

AST 4.1 - Obtains information to identify where water is found on Earth and that it can be solid or liquid.(2-ESS2-3)

AST 4.2 - Compares multiple solutions designed to slow or prevent wind or water from changing the shape of the land.(2-ESS2-1)

AST 4.3 - Develops a model to represent the shapes and kinds of land and bodies of water in an area.(2-ESS2)

AST 4.4 - Uses information from several sources to provide evidence that Earth events can occur quickly or slowly.(2-ESS1-1)

ALT5: Physical Science: Uses investigations and evidence to describe material changes and their purposes, as determined by their properties..

AST 5.1 - Plans and conducts an investigation to describe and classify different kinds of materials by their observable properties.(2-PS1-1)

AST 5.2 - Analyzes data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.(2-PS1-2)

AST 5.3 - Makes observations to construct an evidence - based account of how an object made of a small set of pieces can be disassembled and made into a new object.(2-PS1-3)

AST 5.4 - Constructs an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot. (2-PS1-4)

Science Learning Targets – 3rd Grade 2020

All classroom instruction and assessments are aligned to BSD Learning Targets

ALT - Academic Learning Target **AST** - Academic Supporting Target

ALT1: Scientific Practices: Explains scientific phenomena using the practices of science through investigation, modeling, argumentation, and use of information.

AST 1.1: Asking Questions - Develops questions and hypothesis/prediction based on scientific principles and observations, with support. Asks questions based on scientific thinking that can be answered by an investigation.

AST 1.2: Developing and Using Models - Develops and uses models and with collaboration revises models, based on evidence that shows the relationships among variables. Begins to identify limitations of models.

AST 1.3: Planning and Carrying Out Investigations - Designs and conducts investigations to gather data. Makes decisions about experimental variables, controls and investigational methods (e.g. number of trials, fair tests). Identifies possible outcomes of investigation.

AST 1.4: Analyzing and Intrepreting Data - Presents data in various formats (bar graphs, pictographs and/or pie charts). With support analyzes and/or compares individual or group data to support explanations about phenomena using logical reasoning, mathematics, and/or computation.

AST 1.5: Mathematical and Computational Thinking - Organizes simple data sets to reveal patterns that suggest relationships. Describes, measures, estimates, and/or graphs quantities (e.g., area, volume, weight, time) to address scientific questions.

AST 1.6: Constructing Explanations - Constructs a claim and supports it with evidence to explain a phenomenon and communicate results.

AST 1.7: Engaging in Argument from Evidence - Engages in argumentation. The student discourse may include evidence, reasoning that links the evidence to their claim and critique of competing arguments during which students build on and question each other's ideas with modeling from the teacher.

AST 1.8: Obtaining, Evaluating and Communicating Information - Reads and begins to compare information to explain phenomenon in multiple sources. Communicates information orally.

ALT 2: Engineering: Defines a problem and proposes solution(s), from which a prototype is built, tested, and evaluated against criteria and constraints.

AST 2.1 - Defines a simple design problem reflecting a need or a want that includes criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1)

A AST 2.2 - Generates and compares possible solutions to a problem based on how well each is likely to meet the criteria and/or constraints of the problem. (3-5-ETS1-2)

AST 2.3 - Plans and carries out fair tests to identify aspects of a model or prototype that can be improved.(3-5-ETS1-3)

ALT3: Life Science: Explains with evidence how life cycles, inherited traits and the environment can affect organisms' development.

AST 3.1 - Develops models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction and death. (3-LS1-1)

AST 3.2 - Constructs an argument that some animals form groups that help members survive. 3.4 - Uses evidence to support the explanation that traits can be influenced by the environment. (3-LS3-2-1)

AST 3.3 - Analyzes and interprets data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms. (3-LS3-1)

AST 3.4 - Uses evidence to support the explanation that traits can be influenced by the environment. (3-LS3-2)

AST 3.5 - Analyzes and interprets data from fossils to provide evidence of the organisms and the environments in which they lived long ago. (3-LS4-1)

AST 3.6 Uses evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. (3-LS4-2)
AST 3.7 Constructs an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. (3-LS4-3)
AST 3.8 Makes a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change. (3-LS4-4)

ALT4: Earth Science: Organizes and uses data to describe typical weather conditions expected during a particular season.

AST 4.1- Represents data in tables and graphical displays to describe typical weather conditions expected during a particular season. (3-ESS2-1)
AST 4.2 - Makes a claim about the merit of a design solution that reduces the impacts of a weather-related hazard. (3-ESS3-1)
AST 4.3 - Obtains and combines information to describe climates in different regions of the world. (3-ESS2-2)

ALT5: Physical Science - Motion and Stability: Explains with evidence how different types of forces affect the motion of an object.

AST 5.1-Plans and conducts an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. (3-PS2-1)
AST 5.2- Makes observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. (3-PS2-2)
AST 5.3- Asks questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. (3-PS2-3)
AST 5.4- Defines (identifies and describes) a simple design problem that can be solved by applying scientific ideas about magnets. (3-PS2-4)

Science Learning Targets – 4th Grade 2020

All classroom instruction and assessments are aligned to BSD Learning Targets

ALT - Academic Learning Target **AST** - Academic Supporting Target

ALT1: Scientific Practices: Explains scientific phenomena using the practices of science through investigation, modeling, argumentation, and use of information.

AST 1.1: Asking Questions - Develops a question and hypothesis/prediction based on scientific principles and observations, with support.

AST 1.2: Developing and Using Models - Develops, uses, and revises models to describe a scientific principle using a simple analogy (e.g., a heron's beak is like a spear), example or symbols.

AST 1.3: Planning and Conducting Investigations - Evaluates investigation design to include appropriate methods (e.g. number of trials, fair tests) and/or tools for collecting data. Makes predictions about what would happen if a variable changes. Effectively conducts investigation to test outcomes.

AST 1.4: Analyzing and Interpreting Data - Represents data in various formats to show the relationship between the outcome and the results collected. Analyzes and/or compares individual or group data to provide evidence for explanations. With support, connects explanations about phenomena using logical reasoning, mathematics, and/or computation.

AST 1.5: Mathematical and Computational Thinking - Uses graphs and/or charts incorporating mathematical skills and concepts to compare outcomes.

AS AST 1.6: Constructing Explanations - Uses multiple sources of evidence, including analyzed data, to explain a phenomenon and communicate results. Connects claim and evidence with reasoning.

AST 1.7: Engaging in Argument from Evidence - Engages in argumentation using data to evaluate claims about cause and effect. Discourse includes evidence, reasoning that links the evidence to their claim and critique of competing arguments during which students build on and question each other's ideas.

AST 1.8: Obtaining, Evaluating, and Communicating Information - Reads and evaluates multiple sources to obtain scientific information to explain phenomenon. Compares and combines information from multiple sources. Communicates information orally and/or in written formats.

ALT 2: Engineering: Defines a problem and proposes solution(s), from which a prototype is built, tested, and evaluated against criteria and constraints.

AST 2.1 - Defines a simple design problem reflecting a need or a want that includes multiple specified criteria for success and constraints on materials, time, or cost. (3-5 - ETS1-1)

AST 2.2 - Generates and compares multiple possible solutions to a problem based on how well each is likely to meet the criteria and/or constraints of the problem. (3-5 - ETS1-2)

AST 2.3 - Plans and carries out fair tests in which variables are controlled to identify aspects of a model or prototype that can be improved based on possible failure points.(3-5 - ETS1-3)

ALT3: Life Science: Structure, Function and Information Processing: Uses models and evidence to argue that plants and animals have structures that support survival, growth, behavior, and reproduction.

AST 3.1- Constructs an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. (4-LS1-1)

AST 3.2 - Uses a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. (4-LS1-2)

ALT4: Earth Science: Processes that Shape the Earth: Uses evidence of weathering and erosion to explain changes to Earth's landscape over time and to develop a solution that reduces the impacts of one of those changes.

AST 4.1-Identifies evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. (4-ESS1-1)

AST 4.2- Makes observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. (4-ESS2-1)

AST 4.3- Analyzes and interprets data from maps to describe patterns of Earth's features. (4-ESS2-2)
AST 4.4- Obtains and combines information to describe that energy and fuels are derived from natural resources and their uses affect the environment. (4-ESS3-1)
AST 4.5- Generates and compares multiple solutions to reduce the impacts of natural Earth processes on humans. (4-ESS3-2)

ALT5: Physical Science: Energy, Waves and their Applications: Uses models, explanations, and scientific designs to demonstrate that energy can be transferred from place to place by sound, light, heat and electrical currents, or collisions.

AST 5.1 Uses evidence to construct an explanation relating the speed of an object to the energy of that object (4-PS3-1)
AST.5.2 Makes observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.(4-PS3-2)
AST 5.3- Asks questions and predict outcomes about the changes in energy that occur when objects collide. (4-PS3-3)
AST 5.4 Applies scientific ideas to design, test, and refine a device that converts energy from one form to another. (4-PS3-4)
AST 5.5 Develops a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move. (4-PS4-1)
AST.5.6 Develops a model to describe that light reflecting from objects and entering the eye allows objects to be seen. (4-PS4-2)
AST 5.7 Generates and compares multiple solutions that use patterns to transfer information. (4-PS4-3)

Science Learning Targets – 5th Grade 2020

All classroom instruction and assessments are aligned to BSD Learning Targets

ALT - Academic Learning Target **AST** - Academic Supporting Target

ALT1: Scientific Practices: Explains scientific phenomena using the practices of science through investigation, modeling, argumentation, and use of information.

AST 1.1: Asking Questions Develops a question and hypothesis/prediction based on scientific principles or patterns, phenomena and observations.

AST 1.2: Developing and using models - Develops, uses, and revises models to describe and/or predict phenomena or show relationships in systems. Uses models to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.

AST 1.3: Planning and Carrying Out Investigations - Makes observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. Predicts outcomes of investigation changes based on scientific background.

AST 1.4: Analyzing and Interpreting Data - Represents data to reveal patterns and connections within results. Analyzes and/or compares individual or group data to provide evidence to support explanations about phenomena using logical reasoning, mathematics, and/or computation reasoning, mathematics, and/or computation.

AST 1.5: Mathematical and Computational Thinking - Determines the appropriate measurements, estimates, and/or graphs (e.g., area, volume, weight, time) to address scientific questions. Creates graphs and/or charts using mathematical skills and concepts to compare outcomes..

AST 1.6: Constructing Explanations - Constructs explanations that focus on explaining how or why a phenomenon occurs and uses appropriate evidence to support their explanations. Connects claim and evidence with reasoning using science ideas.

AST 1.7: Engaging in Argument from Evidence - Engages in, compares, refines, and critiques arguments based on an evaluation of the evidence presented. Distinguishes among facts, theories and opinions. Constructs, builds on, and/or supports an argument with evidence, data, and/or a model.

AST 1.8: Obtaining, Evaluating and Communicating Information - Reads and evaluates multiple sources to obtain scientific information to explain phenomenon. Compares and combines information from multiple sources considering the strengths of the information and sources and communicates the information.

ALT 2: Engineering: Defines a problem and proposes at least two solutions that are built, tested, and compared against criteria and constraints.

AST 2.1 - Defines a simple design problem reflecting a need or a want that includes multiple specified criteria for success and constraints on materials, time, and/or cost. (3-5 - ETS1-1)

AST 2.2 - Generates and compares multiple possible solutions to a problem based on how well each is likely to meet the criteria and/or constraints of the problem. (3-5 - ETS1-2)

AST 2.3 - Plans and carries out fair tests in which variables are controlled and failure points are considered, prior to and after testing, to identify aspects of a model or prototype that can be improved.(3-5 - ETS1-3)

ALT3: Life Science: Matter and Energy Transfer in Organisms: Develops and uses models to describe how matter and energy are transferred between plants, animals and decomposers and how all energy for life is derived from the sun.

AST 3.1 Support an argument that plants get the materials they need for growth chiefly from air and water (5-LS1-1).

AST 3.2 Uses models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun. (5-PS3-1)

AST 3.3 Develops a model to describe the movement of matter among plants, animals, decomposers, and the environment. (5-LS2-1)

ALT4: Earth Science - Sun and Stars: Creates and uses graphs to Identify patterns on the effect of light from the sun on the earth. Supports an argument that relates the relative brightness of stars to their distance from earth.

AST 4.1 - Supports an argument that the apparent brightness of the sun and stars is due to their relative distances from the Earth. (ESS1-1)
AST 4.2 - Represents data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. (5-ESS1-2)
AST 4.3 - Supports an argument that the gravitational force exerted by Earth on objects is directed down. (5-PS2-1)

ALT5: Earth Science - Earth Systems: Models how earth's systems interact and communicate how communities use science ideas to protect Earth's resources and environment.

AST 5.1 - Develops a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. (5-ESS2-1)
AST 5.2 - Describes and graphs the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.(5-ESS2-2)
AST 5.2 - Obtains and combines information about ways individual communities use science ideas to protect the Earth's resources and environment. (5-ESS3-1.)

ALT6: Physical Science- Matter: Observes and measures properties of matter, develops a model that describes how matter is made of particles too small to be seen, then constructs an explanation that explains why matter is conserved even when it changes.

AST 6.1 - Develops a model to describe that matter is made of particles too small to be seen. (5-PS1-1)
AST 6.2 - Measures and graphs quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved. (5-PS1-2)
AST 6.3 - Conducts an investigation to determine whether the mixing of two or more substances results in new substances. (5-PS1-4)
AST 6.4 - Makes observations and measurements to identify materials based on their properties. (5-PS1-3)
AST 6.5 - Support an argument that the gravitational force exerted by Earth on objects is directed down. (5-PS2-1)

Science Learning Targets – 6th Grade 2020

All classroom instruction and assessments are aligned to BSD Learning Targets

ALT - Academic Learning Target **AST** - Academic Supporting Target

ALT1 - Science Practices: Uses the practices of science inquiry to design, investigate, model, and explain phenomena using appropriate tools, techniques, and variables.

AST 1.1 - Asks Questions - Asks testable questions that arise from observations of phenomena, models, or unexpected results.

AST 1.2 - Develops and Uses Models - Develops, uses, evaluates, and revises models to describe, test, and predict phenomena.

AST 1.3 - Designs Investigations - Plans and carries out investigations that identify and appropriately measure variables to provide data as evidence to support explanations or solutions.

AST 1.4 - Analyzes and Interprets Data - Analyzes and interprets data, using graphical displays, to provide evidence for phenomena

AST 1.5 - Mathematical and Computational Thinking - Uses mathematical and computational thinking to identify patterns and trends in data sets in order to evaluate and support scientific conclusions.

AST 1.6 - Constructs Explanations - Constructs explanations based on valid and reliable evidence and applies scientific ideas and principles to explain the phenomena.

AST 1.7 - Engages in Argument from Evidence - Engages with evidence to construct or critique a convincing argument that supports or refutes a claim and uses argumentation to listen to, compare, and evaluate competing ideas supported by scientific reasoning.

ALT2 - Engineering Design: Designs, constructs, tests and evaluates a solution to a defined problem using appropriate tools and materials**.**

AST 2.1 - Defines the Problem - Defines the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. (MS-ETS1-1)

AST 2.2 - Evaluates Competing Solutions - Evaluates competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. (MS-ETS1-2)

AST 2.3 - Analyzes Design Solutions - Analyzes data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. (MS-ETS1-3)

AST 2.4 - Develops and Iterates Solutions - Develops a model or prototype to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. (MS-ETS1-4)

ALT3 - Disciplinary Core Ideas: Uses the disciplinary core ideas of science to explain phenomena and design solutions

AST 3.1 - Molecules to Organisms - Demonstrates knowledge that cells have a definite structure and function that contribute to an organism's growth, development and behavior. (MS-LS1)

AST 3.2 - Heredity: Inheritance and Variation of Traits - Demonstrates knowledge that cells pass traits from one generation to the next. (MS-LS3)

AST 3.3 - Earth's Systems - Demonstrates knowledge of the causes of weather patterns and regional climates. (MS-ESS2)

AST 3.4 - Earth and Human Activity - Demonstrates knowledge of how human activities affect global environmental change. (MS-ESS3)

AST 3.5 – Energy - Demonstrates knowledge of heat, temperature, and thermal energy. (MS-PS3)

<u>ALT4 - Science and Society</u>: Constructs an explanation of how science and engineering influence our understandings, decisions, and changes to societies over time.

AST 4.1 - Interdependence of Science and Technology - Synthesizes how science and engineering have supported the development of scientific theories, technology, and changes to society.

AST 4.2 - Scientific Ethics - Evaluates the short and long term effects of applying scientific understanding to address issues in the natural world and society.

AST 4.3 - Personal Impacts - Articulates the impacts of personal, traditional, and community knowledge and practices on the natural world and society.

<u>ALT5 - Literacy in Science:</u> Obtains, reads, evaluates, and communicates scientific information.

AST 5.1 - Obtains Information - Obtains information from multiple credible sources.

AST 5.2 - Reads Informational Text - Reads informational text critically to determine the central ideas or conclusions, collect evidence, and/or obtain scientific information.

AST 5.3 - Evaluates Sources - Evaluates the evidence, bias, and usefulness of multiple information sources (scientific, technical, text-based, and media / visual).

AST 5.4 - Communicates Ideas - Communicates and synthesizes scientific and/or technical information or ideas in multiple formats effectively (including orally, graphically, textually, and mathematically).

Science Learning Targets – 7th Grade 2020

All classroom instruction and assessments are aligned to BSD Learning Targets

ALT - Academic Learning Target **AST** - Academic Supporting Target

ALT1 - Science Practices: Uses the practices of science inquiry to design, investigate, model, and explain phenomena using appropriate tools, techniques, and variables**.**

AST 1.1 Asks Questions - Asks testable questions that arise from observations of phenomena, models, or unexpected results.

AST 1.2 Develops and Uses Models - Develops, uses, evaluates, and revises models to describe, test, and predict phenomena.

AST 1.3 - Designs Investigations - Plans and carries out investigations that identify and appropriately measure variables to provide data as evidence to support explanations or solutions.

AST 1.4 - Analyzes and Interprets Data - Analyzes and interprets data, using graphical displays, to provide evidence for phenomena

AST 1.5 - Mathematical and Computational Thinking - Uses mathematical and computational thinking to identify patterns and trends in data sets in order to evaluate and support scientific conclusions.

AST 1.6 - Constructs Explanations - Constructs explanations based on valid and reliable evidence and applies scientific ideas and principles to explain the phenomena..

AST 1.7 - Engages in Argument from Evidence - Engages with evidence to construct or critique a convincing argument that supports or refutes a claim and uses argumentation to listen to, compare, and evaluate competing ideas supported by scientific reasoning..

ALT2 - Engineering Design: Designs, constructs, tests and evaluates a solution to a defined problem using appropriate tools and materials**.**

AST 2.1 - Defines the Problem - Defines the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. (MS-ETS1-1)

AST 2.2 - Evaluates Competing Solutions - Evaluates competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. (MS-ETS1-2)

AST 2.3 - Analyzes Design Solutions - Analyzes data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. (MS-ETS1-3)3)

AST 2.4 - Develops and Iterates Solutions - Develops a model or prototype to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. (MS-ETS1-4)

ALT3 - Disciplinary Core Ideas: Uses the disciplinary core ideas of science to explain phenomena and design solutions

AST 3.1 - Molecules to Organisms - Demonstrates knowledge of the organization of matter in living and nonliving systems and how energy and molecules flow through those systems.(MS-LS-1; MS-LS-2)

AST 3.2 - Ecosystems: Interactions, Energy, and Dynamics - Demonstrates knowledge of the relationships and dynamics within ecosystems; including between humans and the environment. (MS-LS2)

AST 3.3 - Earth's Systems - Demonstrates knowledge of how Earth's surface changes over time due to water and Earth's processes driven by the cycling of energy in the Earth. (MS-ESS2)

AST 3.4 - Earth and Human Activity - Demonstrates knowledge of the role of geological processes and human activities on the unequal distribution of natural resources and natural hazards.(MS-ESS3)

AST 3.5 - Matter and Its Interactions - Demonstrates knowledge of the structure and properties of matter, the reactions that occur between chemicals, and thermal energy. (MS-PS1)

ALT4 - Science and Society: Constructs an explanation of how science and engineering influence our understandings, decisions, and changes to societies over time.

AST 4.1 - Interdependence of Science and Technology - Synthesizes how science and engineering have supported the development of scientific theories, technology, and changes to society.

AST 4.2 - Scientific Ethics - Evaluates the short and long term effects of applying scientific understanding to address issues in the natural world and society.

AST 4.3 - Personal Impacts - Articulates the impacts of personal, traditional, and community knowledge and practices on the natural world and society.

ALT5 - Literacy in Science: Obtains, reads, evaluates, and communicates scientific information.

AST 5.1 - Obtains Information - Obtains information from multiple credible sources.

AST 5.2 - Reads Informational Text - Reads informational text critically to determine the central ideas or conclusions, collect evidence, and/or obtain scientific information.

AST 5.3 - Evaluates Sources - Evaluates the evidence, bias, and usefulness of multiple information sources (scientific, technical, text-based, and media / visual).

AST 5.4 - Communicates Ideas - Communicates and synthesizes scientific and/or technical information or ideas in multiple formats effectively (including orally, graphically, textually, and mathematically).

Science Learning Targets – 8th Grade 2020

All classroom instruction and assessments are aligned to BSD Learning Targets

ALT - Academic Learning Target **AST** - Academic Supporting Target

ALT1 - Science Practices: Uses the practices of science inquiry to design, investigate, model, and explain phenomena using appropriate tools, techniques, and variables.

T 1.1 Asks Questions - Asks testable questions that arise from observations of phenomena, models, or unexpected results.

AST 1.2 Develops and Uses Models - Asks testable questions that arise from observations of phenomena, models, or unexpected results.

AST 1.3 - Designs Investigations - Plans and carries out investigations that identify and appropriately measure variables to provide data as evidence to support explanations or solutions.

AST 1.4 - Analyzes and Interprets Data - Analyzes and interprets data, using graphical displays, to provide evidence for phenomena.

AST 1.5 - Mathematical and Computational Thinking - Uses mathematical and computational thinking to identify patterns and trends in data sets in order to evaluate and support scientific conclusions.

AST 1.6 - Constructs Explanations - Constructs explanations based on valid and reliable evidence and applies scientific ideas and principles to explain the phenomena.

AST 1.7 - Engages in Argument from Evidence - Engages with evidence to construct or critique a convincing argument that supports or refutes a claim and uses argumentation to listen to, compare, and evaluate competing ideas supported by scientific reasoning.

ALT2 - Engineering Design: Designs, constructs, tests and evaluates a solution to a defined problem using appropriate tools and materials**.**

AST 2.1 - Defines the Problem - Defines the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. (MS-ETS1-1)

AST 2.2 - Evaluates Competing Solutions - Evaluates competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. (MS-ETS1-2)

AST 2.3 - Analyzes Design Solutions - Analyzes data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. (MS-ETS1-3)

AST 2.4 - Develops a model or prototype to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. (MS-ETS1-4)

ALT3 - Disciplinary Core Ideas: Uses the disciplinary core ideas of science to explain phenomena and design solutions

AST 3.1 - Heredity: Inheritance and Variation of Traits - Demonstrates knowledge that traits are variable and are the result of genes made of DNA that encodes proteins. (MS-LS3)

AST 3.2 - - Biological Evolution: Unity and Diversity - Demonstrates knowledge that organisms evolve via natural selection and that multiple lines of evidence support the theory of evolution. (MS-LS4)

AST 3.3 - Earth's Place in the Universe - Demonstrates knowledge of systems at varying spatial scales (planet, solar system, galaxy, universe) to explain observable phenomena in space, the role of gravity, and Earth's history. (MS-ESS1)

AST 3.4 - Earth and Human Activity - Demonstrates knowledge of the impact increasing human populations have on Earth. (MS-ESS3)

AST 3.5 - Motion and Stability: Forces and Interactions - Demonstrates knowledge of Newton's laws, including how a variety of forces and the interactions between those forces impact objects. (MS-PS2)

AST 3.6 – Energy - Demonstrates knowledge of the types of energy and explains the relationship between energy and forces. (MS-PS3)

AST 3.7 - Waves and their Applications in Technologies for Information Transfer - Demonstrates knowledge of mathematical representations and models that describe the energy of a wave, the way waves interact with materials, and how waves transmit information. (MS-PS4)

ALT4 - Science and Society: Constructs an explanation of how science and engineering influence our understandings, decisions, and changes to societies over time.

AST 4.1 - Interdependence of Science and Technology - Synthesizes how science and engineering have supported the development of scientific theories, technology, and changes to society.

AST 4.2 - Scientific Ethics - Evaluates the short and long term effects of applying scientific understanding to address issues in the natural world and society.

AST 4.3 - Personal Impacts - Articulates the impacts of personal, traditional, and community knowledge and practices on the natural world and society.

ALT5 - Literacy in Science: Obtains, reads, evaluates, and communicates scientific information.

AST 5.1 - Obtains Information - Obtains information from multiple credible sources.

AST 5.2 - Reads Informational Text - Reads informational text critically to determine the central ideas or conclusions, collect evidence, and/or obtain scientific information.

AST 5.3 - Evaluates Sources - Evaluates the evidence, bias, and usefulness of multiple information sources (scientific, technical, text-based, and media / visual).

AST 5.4 - Communicates Ideas - Communicates and synthesizes scientific and/or technical information or ideas in multiple formats effectively (including orally, graphically, textually, and mathematically).

Science Learning Targets - Elementary Primary Specialized Classrooms (ALC, SRC, SLC), and ISCs K-12

ALC – Academic Learning Center
SRC – Structured Routines Center
SLC – Structured Learning Center
ISC – Independent Skills Center

With verbal, visual, or physical prompting...

ALT 1: Demonstrates problem solving skills.

AST 1.1 Tackles a Challenge
AST 1.2 Thinks creatively
AST 1.3 Uses multiple approaches to solving a problem

ALT2: Demonstrates focused attention to pursue curiosity.

AST 2.1 Exhibits curiosity and imagination
AST 2.2 Asks questions about the natural and designed worlds
AST 2.3 Engages in novel activities to explore questions.

ALT3: Demonstrates communication skills

AST 3.1 Answers "wh" questions
AST 3.2 Responds to peer interaction
AST 3.3 Communicates ideas

ALT4: Notices relationships in patterns and organizes items based on observed details

AST 4.1 Communicates cause and effect relationships
AST 4.2 Sorts objects using various criteria
AST 4.3 Creates and notices patterns

Intermediate Elementary ALC, SRC, and SLC Science Learning Targets

ALC – Academic Learning Center
SRC – Structured Routines Center
SLC – Structured Learning Center

ALT1: Scientific Practices: Explains scientific phenomena using the practices of science through investigation, modeling, argumentation, and use of information**.**

AST 1.1: Ask Question about nature or human-made world with verbal, visual, or physical guidance.
AST 1.2: Developing and Using Models - With visual, verbal, or physical guidance, identifies, uses, and develops models that represent concrete events. Distinguishes between a model, the actual phenomenon, and other models.
AST 1.2 A: Developing and Using Models - With visual, verbal, or physical guidance, identifies, uses, and develops models that represent concrete events. Compares between a model, the actual phenomenon, and other models.
AST 1.3: Planning and Conducting Investigations - With visual, verbal, or physical guidance, collect and share data from an investigation with peers.
AST 1.3 A: Planning and Conducting Investigations - With visual, verbal, or physical guidance, plans and conducts an investigation in collaboration with peers.
AST 1.4: Analyzing and Interpreting Data - With visual, verbal, or physical guidance collects and shares data from an investigation with peers and compares predictions to what occurred.
AST 1.4 A: Analyzing and Interpreting Data - With visual, verbal, or physical guidance, collects and shares data from an investigation with peers and compares predictions to what occurred.
AST 1.5: Mathematical and Computational Thinking - With visual, verbal or physical guidance, uses counting and numbers to identify and describe patterns in the natural world. Uses and compares quantitative and qualitative data.
AST 1.6: Constructing Explanations - With visual, verbal or physical guidance, uses information from observations to identify and describe patterns in the natural world.
AST 1.6 A: Constructing Explanations - With visual, verbal or physical guidance, uses information from observations to construct an evidence-based explanation for natural phenomena.
AST 1.7: Engaging in Argument from Evidence- With guidance, listens actively to others' explanations and arguments and asks questions for clarification AND distinguish between opinion and evidence.
AST 1.8: Obtains, Evaluates, and Communicates Information - With visual, verbal or physical guidance, reads grade-appropriate texts and uses media to obtain scientific and technical information. Communicates AND clarify information.

ALT 2: Engineering: Shares ideas about a simple defined problem, plans a possible solution, builds it with suggested materials, and considers whether the design met criteria**.**

AST 2.1 With visual, verbal or physical guidance 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. (K-2- ETS1-1)
AST 2.2 - Develop a simple drawing, or physical model to solve a given problem with verbal, visual or physical guidance. (ETS1-2)
AST 2.2 A Develop a drawing, or physical model to show how the form of an object helps it function as needed to solve a given problem with visual, verbal or physical guidance. (K-2- ETS1-2)
AST 2.3 - Compare the strengths and weaknesses of the design of two objects that solve the same problem. (ETS1-3)
AST 2.3 A Compare the strengths and weaknesses based on evidence from tests of two objects designed to solve the same problem with verbal, visual or physical guidance. (K-2- ETS1-3)

ALT 3: Life Science: Explains earth science concepts including weather, human impacts on the environment, and patterns of the sun, moon, and earth**.**

AST 3.1 - Uses observations to describe patterns of what plants and animals (including humans) need to survive with visual, verbal or physical guidance. (K-LS1-1)

AST 3.2 - Uses materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs with visual, verbal or physical guidance. (1-LS1-1)

AST 3.3 - Reads texts and use media to determine patterns in behavior of parents and offspring that help offspring survive with visual, verbal or physical guidance. (1-LS1-2)

AST 3.4 - Makes observations to construct an evidence - based account that young plants and animals are like, but not exactly like, their parents with visual, verbal or physical guidance. (1-LS3-1)

ALT4: Earth Science: Explains earth science concepts including weather, human impacts on the environment, and patterns of the sun, moon, and earth.

AST 4.1 - Uses and shares observations of local weather conditions to describe patterns over time with visual, verbal or physical guidance. (K-ESS2-1)

AST 4.2 - Constructs an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs with visual, verbal or physical guidance. (K-ESS2-2)

AST 4.3 - Uses a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live with visual verbal or physical guidance. (K-ESS3-1)

AST 4.4 - With visual, verbal or physical guidance will ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather. (KESS3-2)

AST 4.5 - With verbal, visual or physical guidance, communicates solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment. (K-ESS3-3)

AST 4.6 - With visual, verbal or physical guidance uses observations of the sun, moon, and stars to describe patterns that can be predicted. (1-ESS1-1)

AST 4.7 - With visual, verbal or physical guidance makes observations at different times of year to relate the amount of daylight to the time of year. (1-ESS1-2)

AST 4.7A - With visual, verbal, or physical guidance identifies patterns of motions of objects in the sky and provide evidence. (1ESS1-3)

ALT5: Physical Science: Investigates physical science concepts, including pushes and pulls and how light and sound work.

AST 5.1 - With physical, visual, or verbal guidance, plans and conducts an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. (K-PS2-1)

AST 5.2 - With physical, visual, or verbal guidance, analyzes 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. (K-PS2-2)

AST 5.3 - With visual, verbal or physical guidance, makes observations to determine the effect of sunlight on Earth's surface. (K-PS33-1)

AST 5.4 - With visual, verbal, or physical guidance, uses tools and materials provided to design and build a structure that will reduce the warming effect of sunlight on Earth's surface. (K-PS3-2)

AST 5.5 - With verbal, visual or physical guidance, plans and conducts investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. (1-PS4-1)

AST 5.6 - With verbal, visual or physical guidance, uses tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance. (1-PS4-4)

AST 5.7 - With verbal, visual or physical guidances, plans and conducts investigations to determine the effect of placing objects made with different materials in the path of a beam of light. (1-PS4-3) AST 5.5 - With visual, verbal or physical guidance, makes observations to construct an evidence - based account that objects in darkness can be seen only when illuminated. (1-PS4-2)

Middle School ALC, SRC, SLC and ACE Science Learning Targets

ALC – Academic Learning Center
SRC – Structured Routines Center
SLC – Structured Learning Center
ACE – Academic and Communication Enhancements

ALT1: Scientific Practices: Explains scientific phenomena using the practices of science through investigation, modeling, argumentation, and use of information, with guidance.

AST 1.1: Asking Questions - Asks and/or identifies questions that can be answered by an investigation.
AST 1.2: Developing and Using Models - Identifies, uses, and develops models that represent patterns, scale, and/or relationships of concrete events. Compares between a model, the actual phenomenon, and other models.
AST 1.3: Planning and Carrying Out Investigations - Plans and conducts an investigation to produce data that can be used as evidence to answer a question.
AST 1.4 - Presents data in various formats (bar graphs, pictographs and/or pie charts). With support, analyzes and/or compares individual or group data to support explanations about phenomena using logical reasoning, mathematics, and/or computation.
AST 1.5: Mathematical Thinking - Uses numbers to identify and describe patterns in the natural world. Describes, measures, estimates, and/or graphs quantities (e.g., area, volume, weight, time) to address scientific questions.
AST 1.6: Constructing Hypothesis - Creates a hypothesis and supports it with evidence to explain what they observed and share it with peers.
AST 1.7: Analyzing the Evidence - Identifies arguments that are supported by evidence, listens actively to others' explanations and arguments and ask questions for clarification, and makes comparisons between opinion and evidence.
AST 1.8: Obtaining, Evaluating and Communicating Information - Reads, comprehends and compares modified texts and media to acquire scientific information.

ALT 2: Engineering: Shares ideas about a simple defined problem, plans a possible solution, builds it with suggested materials, and compares/contrasts objects designed to solve the same problem, with guidance.

AST 2.1 - Ask questions, make observations, and gather information about a situation people want to change to define a simple problem with criteria that can be solved through the development of a new or improved object or tool.(K-2 ETS1-1)
AST 2.2 - Uses a variety of visual supports to construct a model of an object. (K-2 ETS1-2)
AST 2.3 - Compares and contrasts two objects designed to solve the same problem and suggest improvements. (K-2 ETS1-3)
AST 2.4 - Defines a simple design problem reflecting a need or a want that includes criteria for success and constraints on materials, time, or cost.
AST 2.5 - Generates and compares possible solutions to a problem based on how well each is likely to meet the criteria and/or constraints of the problem.
AST 2.6 - Plans and carries out fair tests to identify aspects of a model or prototype that can be improved.

ALT 3: Life Science: Uses observations to describe what plants need to survive and grow and uses models to explore life cycles and heredity.

AST 3.1 - Plans and conducts an investigation to determine if plants need sunlight and water to grow. (LS2-1)
AST 3.2 - Develops a simple model that mimics the function of an animal in dispersing seeds or pollinating plants (LS2-2.)
AST 3.3 - Makes observations of plants and animals to compare the diversity of life in different habitats. (2-LS4-1)
AST 3.4 - Develops models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction and death. (3-LS1-1)
AST 3.5 - Provides evidence that some animals form groups that help members survive. (3-LS2-1)

AST 3.6 - Analyzes data to provides evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms. (3-LS3-1)
AST 3.7 - Uses evidence to support the explanation that traits can be influenced by the environment. (3-LS3-2)
AST 3.8 - Analyzes data from fossils to provide evidence of the organisms and the environments in which they lived long ago. (3-LS4-1)
AST 3.9 - Uses evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. (3-LS4-2)
AST 3.10 - Constructs an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. (3-LS4-3)
AST 3.11 - Makes a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change. (3-LS4-4)

ALT4: Earth Science: Explains earth science concepts including weather, climate, water, and wind, and their impacts on the environment, landscapes, and people**.**

AST 4.1 - Obtains information to identify where water is found on Earth and that it can be solid or liquid.(2-ESS2-3)
AST 4.2 - Compares multiple solutions designed to slow or prevent wind or water from changing the shape of the land. (2-ESS2-1)
AST 4.3 - Develops a model to represent the shapes and kinds of land and bodies of water in an area.(2-ESS2-2)
AST 4.4 - Uses information from several sources to provide evidence that Earth events can occur quickly or slowly.(2-ESS1-1)
AST 4.5 - Represents data in tables and graphical displays to describe typical weather conditions expected during a particular season. (3-ESS2-1)
AST 4.6 - Obtains and combines information to describe climates in different regions of the world. (3-ESS2-2)
AST 4.7 - Makes a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.

ALT5: Physical Science: Investigates physical science concepts related to matter and energy.

AST 5.1 - Plans and conducts an investigation to describe and classify different kinds of materials by their observable properties.(2-PS1-1)
AST 5.2 - Analyzes data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.(2-PS1-2)
AST 5.3 - Makes observations to construct an evidence - based account of how an object made of a small set of pieces can be disassembled and made into a new object.(2-PS 1-3)
AST 5.4 - Constructs an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.(2-PS1-4)
AST 5.5 - Plans and conducts an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. (3-PS2-1)
AST 5.6 - Makes observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. (3-PS2-2)
AST 5.7 - Asks questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. (3-PS2-3)
AST 5.8 - Defines a simple design problem that can be solved by applying scientific ideas about magnets. (3-PS2-4)

High School ALC, SRC, SLC Science Learning Targets

ALC – Academic Learning Center
SRC – Structured Routines Center
SLC – Structured Learning Center

ALT1: Scientific Practices: Explains scientific phenomena using the practices of science through investigation, modeling, argumentation, and use of information.

AST 1.1 - Develops questions and hypothesis/prediction based on scientific principles and observations, with support. Asks questions based on scientific thinking that can be answered by an investigation.
AST 1. 2 - Develops and uses models and with collaboration revises models, based on evidence that shows the relationships among variables. Begins to identify limitations of models.
AST 1.3 Designs and conducts investigations to gather data. Makes decisions about experimental variables, controls and investigational methods (e.g. number of trials, fair tests). Identifies possible outcomes of investigation.
AST 1.4 - Presents data in various formats (bar graphs, pictographs and/or pie charts). With support analyzes and/or compares individual or group data to support explanations about phenomena using logical reasoning, mathematics, and/or computation.
AST 1.5 - Organizes simple data sets to reveal patterns that suggest relationships. Describes, measures, estimates, and/or graphs quantities (e.g., area, volume, weight, time) to address scientific questions.
AST 1.6 - Constructs a claim and supports it with evidence to explain a phenomenon and communicate results.
AST 1.7 - Engages in argumentation. The student discourse may include evidence, reasoning that links the evidence to their claim and critique of competing arguments during which students build on and question each other's ideas with modeling from the teacher.
AST 1.8 - Reads and compares information to explain phenomenon in multiple sources. Communicates information orally.

ALT 2: Engineering Design: Defines a problem and proposes solution(s), from which a prototype is built, tested, and evaluated against criteria and constraints.

AST 2.1 - Defines a simple design problem reflecting a need or a want that includes criteria for success and constraints on materials, time, or cost. (3-5 - ETS1-1)
AST 2.2 - Generates and compares possible solutions to a problem based on how well each is likely to meet the criteria and/or constraints of the problem. (3-5 - ETS1-2)
AST 2.3 - Plans and carries out fair tests to identify aspects of a model or prototype that can be improved.(3-5 - ETS1-3)

ALT3: Life Science: Structure, Function and Information Processing: Uses models and evidence to argue that plants and animals have different functions in an ecosystem, which support their survival, growth, and reproduction.

AST 3.1- Constructs an argument that plants and animals, including humans with organs and organ systems, have internal and external structures that function to support survival, growth, behavior, and reproduction. (4-LS1-1)
AST 3.2- Uses a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. (4-LS1-2)
AST 3.3 Supports an argument that plants get the materials they need for growth chiefly from air and water (5-LS1-1).)
AST 3.4 Uses models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun. (5-PS3-1)
AST 3.5 Develops a model to describe the movement of matter among plants, animals, decomposers, and the environment. (5-LS2-1)

AST 3.6 Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. (MS-LS1-3)

ALT4: Earth Science: Processes that Shape the Earth: Explains earth science concepts including erosion, interactions between earth's systems, and water.

AST 4.1- Makes observations and/or measurements to provide evidence of the effects of erosion by water, ice, wind, or vegetation. (4 - ESS2-1)

AST 4.2- Analyzes and interpret data from maps to describe patterns of Earth's features. (4-ESS2-2)

AST 4.3- Obtains and combines information to describe that energy and fuels are derived from natural resources and their uses affect the environment. (4-ESS3-1)

AST 4.4- Generates and compares multiple solutions to reduce the impacts of natural Earth processes on humans. (4-ESS3-2)

AST 4.5 - Develops a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. (5-ESS2-1)

AST 4.6 - Describes and graphs the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.(5-ESS2-2)

AST 4.7 - Obtains and combines information about ways individual communities use science ideas to protect the Earth's resources and environment. (5-ESS3-1.)

ALT5: Physical Science: Matter and Energy: Describes physical science concepts including matter and its properties and energy.

AST 5.1 Uses evidence to construct an explanation relating the speed of an object to the energy of that object (4-PS3-1)

AST 5.2 Makes observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.(4-PS3-2)

AST 5.3- Asks questions and predict outcomes about the changes in energy that occur when objects collide. (4-PS3-3)

AST 5.4 - Provides evidence that substances sometimes change when heating, cooling, or mixing with other substances, and sometimes they do not. (related to 5-PS1-2)

AST 5.5 - Conducts an investigation to determine whether the mixing of two or more substances results in new substances. (5-PS1-4)

AST 5.6 - Makes observations and measurements to identify materials based on their properties. (5-PS1-3)

Phase 2 Science Instructional Resource Adoption Recommendation
Elementary, Middle School, HS Supplemental and K-12 Special Education

Pre-K and Kindergarten:

- **Pre-K and K Science Instructional Model:** The design of the Pre-K and Kindergarten instructional models will revolve around on lines of inquiry and a student-led emergent curriculum. In this culturally and developmentally responsive instructional style, teachers observe and note the questions and ideas students develop during intentional science-focused, play-based experiences. Using knowledge of the NGSS standards, teachers will guide students through inquiry cycles to further both their science knowledge and investigation and problem-solving skills. For example, one of the Kindergarten NGSS standards is, "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." For students to form a deep understanding of forces, and to conduct investigations to discover their patterns, students should have opportunities to explore those skills and ideas throughout the year. To meet this standard, teachers will be provided with materials related to pushes and pulls, such as blocks, toy cars, and construction sets. Teachers will focus on developing lines of inquiry alongside their students, based on the questions students develop through play. These experiences will be founded in the NGSS practices, crosscutting concepts, and disciplinary core ideas, but will be student-directed and play-based. Lines of questioning and strategies will connect to science and engineering practices (e.g. asking questions and designing investigations), core ideas (e.g. pushes and pulls), and crosscutting concepts (e.g. cause and effect).
- **Pre-K Habits of Mind** is our PreK Framework for observing children and designing learning opportunities in BSD. This framework will be utilized in the design of our Pre-K and K Science program. The habits of mind most connected to science are:
    - Thinking strategically, creatively and reflectively to follow an interest and tackle a challenge
    - Focusing attention to pursue an interest, gratify curiosity, respond to a challenge, or try out an idea.
    - Noticing relationships, making connections and organizing items based on observed details
    - Collaborating with others to accomplish a shared goal

- **Instructional Resources:**
    - The recommended primary instructional resource for Pre-K and Kindergarten are the lines of inquiry developed by teachers in response to their observations of students' play. This includes district created resources for teachers to support play-based inquiry, classroom equipment/manipulatives, books that connect to the standards, and the natural world students will encounter.
        - For both Pre-K and Kindergarten, the following types of equipment are recommended for purchase, to support student-directed and inquiry-based learning (in lieu of Twig kits and student workbooks). These will be used to build more varied lines of inquiry for students in Engineering and Earth, Life, and Physical Sciences:
            - **Life Science:** Ant farm (Pre-K) and Worm habitat (K), magnifying glasses to explore collections of natural objects, and plant growing kits.
            - **Physical Science and Engineering:** K'nex (engineering manipulatives) kit, blocks, and ramp/ball sets to explore pushes and pulls and engage in the engineering design process.

        - **Earth Science:** UV beads and various types of materials, plus exploration of outside spaces like the playground to investigate how materials and surfaces interact with the environment.
    - For Kindergarten, the Twig Science program is recommended as a supplement. Including the 8-year Teacher Digital Platform, 8-year Media Suite, and Twig Science Reporter.

Grades 1-5

The Project Team recommends Twig Science as the primary instructional resource for Elementary, with supplementary use in Kindergarten. For information on the Twig Science Program and its evidence of efficacy, see Appendix A. In Grades 1-5, the following components of the Twig Science Program are recommended for adoption:

- 8-year Teacher Digital Platform and Digital Assessments
- 8-year Student Digital Platform
- 8-year Media Suite
- Print Teacher Edition
- 8-years of yearly printed Student Twig Books
- Modular Science Kits (1 year consumable and non-consumables)
- Grades 3-5 Science Essentials Kits
- Authentic text sets that connect to NGSS

Grades 6-8

The Project Team recommends the IQWST Integrated Edition from Activate Learning as the primary instructional resource for middle schools. For information on the IQWST Program and its evidence of efficacy, see Appendix B. The following components of the IQWST Program are recommended for adoption:

- 8-year Teacher Digital Platform and Digital Assessments - this is the Interactive Digital Edition for teachers that includes an assessment bank, teacher files, student files, and help/support.
- Print Teacher Edition
- 8-year Student Portal Access - this is where students can access the assignments, texts, and assessments in the curriculum, which will be accessible in Canvas.
- Classroom sets of Student Print Editions - student textbooks, each classroom would get a class set of each grade level text set.
- Science Kits (non-consumables and 1 year consumables)
- 7 years of consumable replenishment kits, purchased yearly.

In addition to the IQWST Integrated Edition, the following supplementary instructional resources are recommended for middle school:

- Vernier measuring devices for data collection (aligned with IQWST units and necessary for their implementation)
- Compound Microscopes
- A yearly budget for consumables that are required for IQWST units but not included in the replenishment kits (mostly food items that the vendor is not allowed to ship).
- Twig Secondary 8-year digital licenses for teachers. Twig Secondary includes a rich media suite, text resources, and interactive simulations.

High School Supplemental Resource

In addition to the Patterns Science instructional resource adopted in Phase 1 of the science adoption, the following supplemental resource is recommended for high school:

- Twig Secondary 8-year digital licenses for teachers. Twig Secondary includes a rich media suite, text resources, and interactive simulations.

K-12 ALC, SRC, SLC, ISC, and ACE Science Adoption Instructional Resource Plan

The following instructional resources have been selected to provide science and engineering experiences for students in Academic Learning Center (ALC), Structured Routines Center (SRC), Structured Learning Center (SLC), Independent Skills Center (ISC), and the Academic Communication Enhancement (ACE) classrooms. The specific resources (a combination of texts, online resources, media, and kits/hands on equipment) will be implemented for each level over time, in collaboration with classroom teachers and in response to student needs and interests. Implementation will start with Twig resources and sets of inquiry and play-based manipulatives at each level. As teachers work with their students and follow their investigative lead, additional opportunities, such as Engineering is Elementary kits, will be added on. This will allow us to respond to teacher and student input on the amount of time they have for science, and what is most engaging, relevant, and effective for learning science in our specialized classrooms. Additionally, please note that the other specialized classrooms (EGC, ELC, and SCC) will use the same on-grade level materials as mainstream classes (see above Pre-K-Kindergarten and Grades 1-5 plans).

Primary Elementary ALC, SRC, and SLC Classrooms, as well as K-12 ISC Classrooms

Summary: Utilization of a combination of hands on equipment and media to provide play and inquiry based learning experiences that support students in developing problem-solving and investigation skills. This approach is in alignment with the pre-K model of student-directed and inquiry based learning.

- Lakeshore Learning - Various inquiry and play-based STEM Learning items
- Amazon - Various inquiry and play-based STEM Learning items
- Constructive Play Things - Various inquiry and play-based STEM Learning items
- Unique - Science text-based materials

Intermediate Elementary ALC, SRC, and SLC Classrooms

Summary: We will utilize a combination of text, unit kits, hands on equipment, and media to provide play and inquiry based learning experiences that support students in developing problem-solving and investigation skills. Additionally, teachers will have access to a variety of kits and instructional resources from Twig Science and engineering kits from Engineering is Elementary.

- Twig Science - Kindergarten and 1st grade level media and lesson resources (modified as needed)
- Engineering is Elementary - Various Engineering Kits
- Unique - Science text-based materials
- Lakeshore Learning - Various inquiry and play-based STEM Learning items
- Amazon - Various inquiry and play-based STEM Learning items

Middle School ALC, SRC, and SLC Classrooms, and the ACE Program

Summary: A combination of text, unit kits, hands on equipment, and media to provide inquiry and engineering learning experiences that support students in developing problem-solving and investigation skills. Additionally, teachers will have access to a variety of kits and instructional resources from Twig Science and engineering kits from Engineering is Elementary.

- Twig - 2nd and 3rd grade level media and lesson resources (modified as needed)
- Engineering is Elementary - Various Engineering Kits
- Unique - Science text-based materials
- Attainment Company - Science Step-by-Step and Explore Life Science, these are science texts specifically designed for students with disabilities
- Amazon - Various inquiry and engineering STEM Learning items

High School ALC, SRC, and SLC Classrooms

Summary: A combination of text, unit kits, hands on equipment, and media to provide inquiry and engineering learning experiences that support students in developing problem-solving and investigation skills. Additionally, teachers will have access to a variety of kits and instructional resources from Twig Science and engineering kits from Engineering is Elementary.

- Twig - 4th and 5th grade level media and lesson resources (modified as needed) - these materials are at an appropriate level for students in these classrooms. The NGSS standards spiral over the grade bands, so these units cover the same topics as high school level standards, but at a level that is more developmentally appropriate.
- Engineering is Elementary - Various Engineering Kits
- Attainment Company - Science Step-by-Step and Explore Biology, these are science texts specifically designed for students with disabilities
- Unique - Science text-based materials
- Amazon - Various inquiry and engineering STEM Learning items

Elementary School Science Adoption
Professional Development Plan

Each Elementary School teacher will participate in the following professional development opportunities (dates are tentative:

Kindergarten Science and Play - Introduction.

- Introduction to Play-Based Inquiry and NGSS at district-wide Kindergarten Ready, Reset, Play PD
- June 2020

Kindergarten NGSS, Lines of Inquiry, and Language Integration
NGSS overview

- Developing emergent curriculum with student-led lines of inquiry, and language integration
- August 2020 (pre-service week)

Grades 1-5 Unit 1 Twig online, NGSS pedagogy, and Unit 1 overview

- Navigating Twig online and Unit 1 (grade level specific), teachers learn the unit's storyline and key inquiry and engineering experiences with NGSS pedagogy embedded.
- August 2020 (pre-service week)

Pre-K NGSS and Play-Based Inquiry and Engineering

- Pre-K teachers will engage in a full day of science and NGSS PD, in alignment with our Pre-K Habits of Mind and student led inquiry model.
- November 2020

Grades 1-5 Unit 2 overview and assessment collaboration

- Unit 2 (grade level specific), teachers learn the unit's storyline and key inquiry and engineering experiences. Afternoon collaboration time to develop assessment plans.
- December 2020

Grades 1-5 Unit 3 overview and language integration

- Unit 3 (grade level specific), teachers learn the unit's storyline and key inquiry and engineering experiences. Afternoon collaboration time to learn and plan language integration strategies (talk protocols, writing supports, etc.).
- Pilot teachers - Feb. 2021. All other teachers - Fall

Grades 1-5 Unit 4 overview and assessment collaboration

- Unit 4 (grade level specific), teachers learn the unit's storyline and key inquiry and engineering experiences. Afternoon collaboration time to develop assessment plans.
- Pilot teachers - April 2021. All other teachers Dec/Jan 2021

Additional collaboration and leadership opportunities:

Science Leaders Summer 2020 Training, 2 teachers per school

- 1 Day NGSS Instructional shifts, language integration, navigating Twig/Carolina online, and 3-dimensional assessment.
- August 2020

Science Leaders PLC - 2 teachers per school

- Two leaders for each school (1 primary and 1 intermediate) to support implementation of the adoption district-wide. Their work will focus on supporting teachers in their building and cross-district collaboration.
- Monthly after school PLC meetings, plus extended contract time for school support

Kindergarten Leadership Team (10 kindergarten teachers)

- 2 Days of PD and Collaboration - Aligning Kindergarten science units with inquiry and play-based Kindergarten model.
- October and December

Middle School Science Adoption
Professional Development Plan

Each Middle School Science teacher will participate in the following professional development opportunities (dates are tentative):

Introduction to IQWST, NGSS pedagogy, and Unit 1 overview

- Day 1 - NGSS Instructional shifts, language integration, navigating IQWST online, and 3-dimensional assessment
- Day 2 - Unit 1 (grade level specific), teachers learn the unit's storyline and key inquiry and engineering experiences, with time in the afternoon for team collaboration.
- August 2020 - Teachers can choose between this 2-day summer session or the Fall unit 1 option

Introduction to IQWST, NGSS pedagogy, and Unit 1 overview

- Navigating IQWST online and Unit 1 (grade level specific), teachers learn the unit's storyline and key inquiry and engineering experiences.
- Mid-September 2020

Unit 2 overview and assessment collaboration

- Unit 2 (grade level specific), teachers learn the unit's storyline and key inquiry and engineering experiences. Afternoon collaboration time to develop assessment plans.
- Mid-Late October 2020

Unit 3 overview and Language Integration

- Unit 3 (grade level specific), teachers learn the unit's storyline and key inquiry and engineering experiences. Afternoon collaboration time to learn and plan language integration strategies (talk protocols, writing supports, etc.)
- January 2021

Unit 4 overview and assessment collaboration

- Unit 4 (grade level specific), teachers learn the unit's storyline and key inquiry and engineering experiences. Afternoon
- January 2021

Additional collaboration and leadership opportunities:

Grade Level TOSAs

- Two 0.2 FTE TOSAs for each grade level to support implementation of the adoption district-wide. Their work will include development of Canvas courses, formative assessments, common summative assessments, creating/modifying differentiated student supports and extensions, and facilitating cross-district collaboration.
- Yearlong

2020 Summer Collaboration time

- Teachers who attend the 2-day summer PD option will have an optional 4 hours to meet with their team (alongside other schools' teams of the same grade level) to plan their implementation of the first unit.
- August (after 2-day training)

District Grade level Professional Learning Communities (PLCs)

- Once per month, each grade level team will meet to support implementation, share ideas, and develop common assessments. Ideally, at least one teacher per school will participate so they can share back with their school team. PLCs will be facilitated by Grade Level TOSAs.
- Once per month, before school via Zoom or after school (depending on teacher preference).

NGSS Twig Science Research

twig EDUCATION

Twig Education, Inc report prepared for:

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TWIG SCIENCE

Twig Science is a complete PK–8 NGSS program built for Oregon. It supports educators as they implement the innovative NGSS by promoting student-centered instruction and three-dimensional learning. Twig Science's hands-on and digital investigative lessons encourage the development of 21st century skills that enable equity for all students in STEM-related opportunities, technical careers, and college advancement. Skills such as critical thinking, problem solving, designing solutions, and making connections across science disciplines provide students with real-world experience—just like working scientists and engineers.

Twig Science is the only program custom-built from the NGSS Framework segments, saving teachers months of professional development. Every module of Twig Science mirrors a segment in the NGSS Framework for a 1:1 alignment.

Grade-level scope and sequences are built into each Teacher Edition, unpacking the NGSS Framework, Coherence, and Progressions. Included are the NGSS Framework segments, Performance Expectations, anchor module phenomena, and unique, engaging STEM storylines.

Performance Expectations are unpacked through their respective three dimensions of Disciplinary Core Ideas, Crosscutting Concepts and Science and Engineering Practices. Engineering, Technology and Applications of Science Standards, plus Environmental Principles and Concepts, are integrated into instruction and assessment across the science disciplines—a fundamental instructional shift.

twig Science | NEXT GEN

NGSS Framework Alignment

GRADE	NGSS TOPIC ARRANGEMENTS	MODULE	MODULE ANCHOR PHENOMENON	CORE PERFORMANCE EXPECTATIONS
GRADE K	Interdependent Relationships in Ecosystems	My Big Nature Adventure	Different plants and animals live in different places.	K-LS1-1, K-ESS3-1
	Forces and Interactions; Engineering Design	Marble Run Engineer	What happens when we push, pull, and drop objects? How can we change their speed and direction?	K-PS2-1, K-PS2-2, K–2-ETS1-1
	Weather and Climate; Engineering Design	Be Prepared	How do we observe weather and collect data to describe weather patterns over time?	K-ESS2-1, K-ESS3-2, K-PS3-1, K-PS3-2, K–2-ETS1-1, K–2-ETS1-2, K–2-ETS1-3
	Interdependent Relationships in Ecosystems	I Can	How can I protect the environment from changes that harm it?	K-ESS2-2, K-ESS3-3, K–2-ETS1-1
GRADE 1	Structure, Function, and Information Processing; Engineering Design	Museum of Leafology	How are all plants alike and how are they different?	1-LS1-1, 1-LS3-1, K–2-ETS1-1, K–2-ETS1-2, K–2-ETS1-3
	Waves; Structure, Function, and Information Processing; Engineering Design	Animal Reporters	How do animals use their body parts, communicate with their young, and make sounds?	1-LS1-2, 1-LS3-1, 1-PS4-1, 1-PS4-4, K–2-ETS1-1, K–2-ETS1-2
	Waves	Shadow Town	Why is the town of Rjukan in a shadow?	1-PS4-2, 1-PS4-3
	Space Systems	Patterns in the Sky	What patterns do we observe in the sky?	1-ESS1-1, 1-ESS1-2
GRADE 2	Earth's Systems	My Journey West	How can we understand and describe the land and water on Earth?	2-ESS2-2, 2-ESS2-3
	Structure and Properties of Matter; Engineering Design	Master of Materials	How can we describe materials as different from one another and understand how their properties relate to their use?	2-PS1-1, 2-PS1-2, 2-PS1-3, 2-PS1-4, K–2-ETS1-2, K–2-ETS1-3
	Earth's Systems; Engineering Design	Save the Island	How do natural processes shape the Earth?	2-ESS1-1, 2-ESS2-1, K–2-ETS1-1, K–2-ETS1-2
	Interdependent Relationships in Ecosystems; Engineering Design	A Garden for Life	How do living things in an environment depend on one another and what do they need to grow?	2-LS2-1, 2-LS2-2, 2-LS4-1, K–2-ETS1-1, K–2-ETS1-2
GRADE 3	Forces and Interactions; Engineering Design	The Ultimate Playground	How are objects affected by the forces of push and pull?	3-PS2-1, 3-PS2-2, 3-PS2-3, 3-PS2-4, 3–5-ETS1-1, 3–5-ETS1-2, 3–5-ETS1-3
	Inheritance and Variation of Traits	Welcome to the Biodome	How do plants' and animals' life cycles help them survive?	3-LS1-1, 3-LS2-1, 3-LS3-1, 3-LS4-2
	Interdependent Relationships in Ecosystems	How to Survive an Ice Age	What is the relationship between an organism and its environment?	3-LS3-2, 3-LS4-1, 3-LS4-3, 3-LS4-4
	Weather and Climate	Weather Warning HQ	What is the weather like around the world?	3-ESS2-1, 3-ESS2-2, 3-ESS3-1, 3–5-ETS1-1, 3–5-ETS1-2
GRADE 4	Energy; Engineering Design	Egg Racers	What happens to energy when objects collide?	4-PS3-1, 4-PS3-3, 3–5-ETS1-3
	Energy; Engineering Design	Sparks Energy, Inc.	How do people produce and transfer energy for their use?	4-ESS3-1, 4-PS3-2, 4-PS3-4, 3–5-ETS1-1, 3–5-ETS1-2
	Earth's Systems	Time-Traveling Tour Guides	How have weathering and erosion sculpted some of Earth's most interesting landscapes?	4-ESS1-1, 4-ESS2-1, 4-ESS2-2, 4-ESS3-2, 3-5-ETS1-2
	Earth's Systems; Engineering Design	Earthquake Engineering	How can we reduce the damage caused by earthquakes?	4-PS4-1, 4-ESS2-2, 4-ESS3-2, 3–5-ETS1-1, 3–5-ETS1-2, 3–5-ETS1-3
	Waves; Structure, Function, and Information Processing	Super Survivors	How do the many parts of my body work together to help me live in the world? Communication involves transferring information through waves or signals.	4-LS1-1, 4-LS1-2, 4-PS3-2, 4-PS4-1, 4-PS4-2, 4-PS4-3, 3–5-ETS1-3
GRADE 5	Structure and Properties of Matter; Engineering Design	Matter Mysteries Hotline	What is matter made of?	5-PS1-1, 5-PS1-2, 5-PS1-3, 5-PS1-4, 3–5-ETS1-3
	Matter and Energy in Organisms and Ecosystems	Yellowstone: Uncovered	How do matter and energy move through an ecosystem?	5-LS1-1, 5-LS2-1, 5-PS3-1
	Earth's Systems; Engineering Design	H2O Response Team	Why do some places lack fresh water and what can we do to protect it?	5-ESS2-1, 5-ESS2-2, 5-ESS3-1, 3–5-ETS1-1, 3–5-ETS1-2, 3–5-ETS1-3
	Space Systems	Galactic Guidebook	What patterns do we notice when we observe the sky?	5-PS2-1, 5-ESS1-1, 5-ESS1-2
GRADE 6	Structure, Function, and Information Processing; Engineering Design	BioTech Systems Worldwide	How do human body systems and subsystems work together?	MS-LS1-1, MS-LS1-2, MS-LS1-3, MS-LS1-8, MS-ETS1-1, MS-ETS1-2
	Weather and Climate; Energy; Engineering Design	Destination Everywhere!	Weather and climate vary around the world, but we can use science and past trends to predict them.	MS-ESS2-4, MS-ESS2-5, MS-ESS2-6, MS-PS3-3, MS-PS3-4, MS-PS3-5, MS-ETS1-1, MS-ETS1-3
	Growth, Development, and Reproduction of Organisms	The Red List	How do the environment and genetics affect animals and plants?	MS-LS1-4, MS-LS1-5, MS-LS3-2, MS-ETS1-1, MS-ETS1-2
	Weather and Climate; Human Impacts; Engineering Design	Cities of the Future	How can we reduce harmful impacts on the environment in the places where people live?	MS-ESS3-3, MS-ESS3-5, MS-LS1-4, MS-LS1-5, MS-ETS1-1, MS-ETS1-2, MS-ETS1-3, MS-ETS1-4

Performance Expectation progressions located on the inside back cover of each Teacher Edition provides back-mapping or forward mapping to each set of three-dimensional standards covered in previous, current, and future grades.

Twig Science is built to spiral so students are introduced to foundational concepts in a grade-appropriate way as early as PK, revisiting them in more complexity in later grades.

Behind Twig Science is a team of teachers, scientists, filmmakers, writers, researchers, academics, and parents, all working together to support teachers in delivering engaging and effective student learning experiences. Our resources are used by over 150,000 teachers, in 60 countries, and in 20 different languages.

At Twig Science, we are proud to have established partnerships with leading universities including Imperial College London and Stanford University. We create our videos with some of the most amazing, awe-inspiring media in the world from the BBC, NASA, CBS, Science Photo Library and Getty Images. Using these and other resources, we combine entertainment with established teaching methods to bring learning to life and our world into the classroom. Most importantly, we work with teachers to ensure our resources are simple, flexible, and enjoyable to use.

To help find and save time for science, the Common Core English Language Arts, WIDA, Mathematics, History–Social Science, and Arts Standards are also provided at point of use in the Scope and Sequence and throughout the program.

MEET OUR COLLABORATIVE THINK TANK

Meet the team or—as we like to think of ourselves—the Twig Science Collaborative Think Thank. The development of Twig Science has been guided by our collective commitment to making science accessible to all. We do this through our engaging, phenomena-based storylines and flexible range of captivating resources, ensuring

that all learners can experience phenomena. Thanks to the thousands of teachers, students and specialists who have advised, reviewed and used Twig Science. From the genesis of NGSS, Twig Science was developed through a collaborative Think Tank of three groups essential to a well-balanced program:

Imperial College London

SCALE
Stanford Center for Assessment, Learning, & Equity

Imperial College London

Our partners and owners. To assure that science and engineering content was 100% accurate and authentic. ICL is an international community, attracting undergraduates from more than 125 countries. Imperial College London is one of the world's most international universities. Imperial’s global collaborations, discoveries and networks are transforming lives and creating opportunities around the world.

The College focuses on the four main disciplines of science, engineering, medicine and business and is renowned for its application of these skills to industry and enterprise. It is consistently ranked among the world’s top ten universities and is ranked by Reuters as one of the World's Most Innovative Universities.

Distinguished members of ICL have included 14 Nobel Laureates and three Fields Medalists. Imperial holds a Silver Athena Swan Award, which recognizes advancing women's careers in science, technology, engineering, math and medicine in academia. Twig Education works closely with Alan Spivey.

Alan Spivey: A professor of chemistry at Imperial College London, Alan leads the scientific review team. He is a committed educator, spearheading the implementation of Imperial's new learning and teaching strategy, an ambitious and exciting project designed to establish it as a global leader in STEM education and active learning.

Stanford SCALE

3-Dimensional Performance Assessments created by STANFORD SCALE to ensure that all assessments are preparing students for 3-D Performance Tasks.

Cathy Zozakiewicz: Cathy provides technical consulting and support through Stanford Center for Assessment, Learning, and Equity (SCALE). Cathy develops innovative, educational, and state-of-the-art performance assessments for evaluating student learning.

Cross-Curricular Experts

A diverse team of Cross-Curricular Experts in English Language Arts, English Language Development, STEAM, and Mathematics to maximize instructional opportunities for transfer within Twig Science and STEM-Based Opportunities. A few of the experts include individuals such as **Wiley Blevins** (ELA/ELD), **Natasha Stillwell** (former TV Science Journalist), **Jan de Lange** (PISA Winner of Mathematics)

Wiley Blevins: An author and reading specialist, Wiley has written several books on reading instruction and teaching students to read informational text. He is a cross-curricular expert with extensive experience in English Language Arts and English Learners, including graduate work in education at Harvard University, elementary classroom teaching, and professional development in the United States, Latin America, and Asia.

Natasha Stillwell: An acclaimed broadcast-science journalist, Natasha Stillwell hosted and produced Discovery Channel's award-winning science and technology show Daily Planet. Natasha has a powerful gift for storytelling and engaging young learners, and she brought these talents to the development of award-winning international online classroom resources Twig and Twig Science Reporter.

Dr. Jan de Lange: Dr. Jan de Lange is director of the Freudenthal Institute and a professor at University of Utrecht in the Netherlands. During his directorate, the Freudenthal Institute was part of the Faculty of Mathematics and Computer Science and had as its task: Innovation in Mathematics Education by Research, Implementation, Dissemination and Professionalization. His research addresses modeling and applications and assessment issues and has broadened to a variety of issues including multimedia and on issues related to implementation.

He served as Co-Principal Investigator of the Assessment Study Group of the National Center for Improving Student Learning and Achievement in Science and Mathematics in the USA. In 1999, a Theoretical Framework for Classroom Assessment was published as the result of this project. In the international comparative assessment area, he has been a member of the international commission for TIMSS-R, and Chairman of the Mathematical Functional Expert Group of the OECD PISA Project.

RESEARCH EVIDENCE BASE

Evidence indicates a thoughtful blend of learning and teaching strategies yields the greatest effect on student learning. Learning attached to students' preconceptions and prior knowledge plays an important role in concept building. Instruction is also most effective when it pursues a deep understanding of concepts. This is accomplished not only by skill building, but by providing multiple examples of the same concept and helping students develop metacognitive skills so that they are actively involved in their own learning.

In addition to the NGSS Framework, Twig Science is based on current research from meta-analysis studies of student outcomes and cognitive psychology. We worked with outstanding teachers, both in the United States and internationally, to pick the best practices for each learning journey. Next, we tested Twig Science in classrooms of students and teachers. From there, iterations were made until we were sure each approach worked successfully.

Current research-based strategies found within Twig Science:

The 5E Instructional Model (Bybee & Landes, 1990) as evidenced in Twig Science 5-Step Lesson Structure:

> **Spark (Engage):** An engaging "hook" activity, which motivates students for the investigations ahead.
>
> **Investigate (Explore):** Students think like scientists and design like engineers, through hands-on, digital, video, and informational text Investigations.
>
> **Report (Explain):** Students articulate what they've learned today, citing evidence and their use of the three dimensions.
>
> **Connect (Elaborate):** Students make connections to the Driving Questions and Module Investigative Problem, while building knowledge of CCCs and SEPs.
>
> **Reflect (Evaluate):** Students use different means to think about what they have learned so far, and how they can use their new understandings to better figure out phenomena/problems.

Teacher Credibility (Hattie)—Background subject knowledge, professional learning, model lessons, and clear instruction in the teacher's edition with suggested questions and sample answers.

Conceptual Change/Building on Misconceptions/Preconceptions (Hattie/EEF)—Pre-Explorations and Progress Trackers.

Language of Science and Classroom Discussion (Hattie, EFF)—UL SCALE Language Routines

The aim of the Twig Science Language Routines is to support questioning strategies as a tool for formative assessment and to promote argumentation. These language routines are based on five ideas:

- Teachers, peers, and texts serve as language resources for learning (Vygotsky, 1978).

- Deep learning of subject content and skills is gained through language, as it is the primary medium of school instruction (Halliday, 1993).
- Through successive and supportive experiences with math ideas, learners make sense of math with their existing language toolkit (Moschkovich, 2012).
- Language is an inseparable part of all human action, so when students are engaged in meaningful activities (projects, presentations, investigations), language develops through perception, interaction, planning, research, and discussion (van Lier & Walqui, 2012).
- Language routines help focus attention on student language that support in-the-moment teacher, peer, and self assessment (Cazden, 2001).

Metacognition and Self-Regulation (Hattie/EEF)—Reflect through class discussions, hands-on, peer-to-peer as well as written responses.

Modeling: Written, Verbal, Visual (EFF)—Lots of modeling in Twig Science, films and 3D, and meta-think alouds.

Formative Assessment/Feedback (Hattie, EFF)—Assessments for learning are embedded in Twig Science**.**

Response to Intervention (Hattie)—We have support at point of use and support for small group work with readers.

Memory—Supporting students to retain knowledge (cognitive load theory, spaced review) (EFF). The modules scaffold learning in bite-sized chunks in lessons and Driving Questions with lots of points to activate prior knowledge and review learning.

Purposeful labs and problem solving (Hattie, EFF)—We do not include random acts of science in Twig Science. The hands-on investigations scaffold to build mastery of phenomena, concepts, and problem solving.

Research base citations and links:

NGSS Framework links: Oregon NGSS Framework

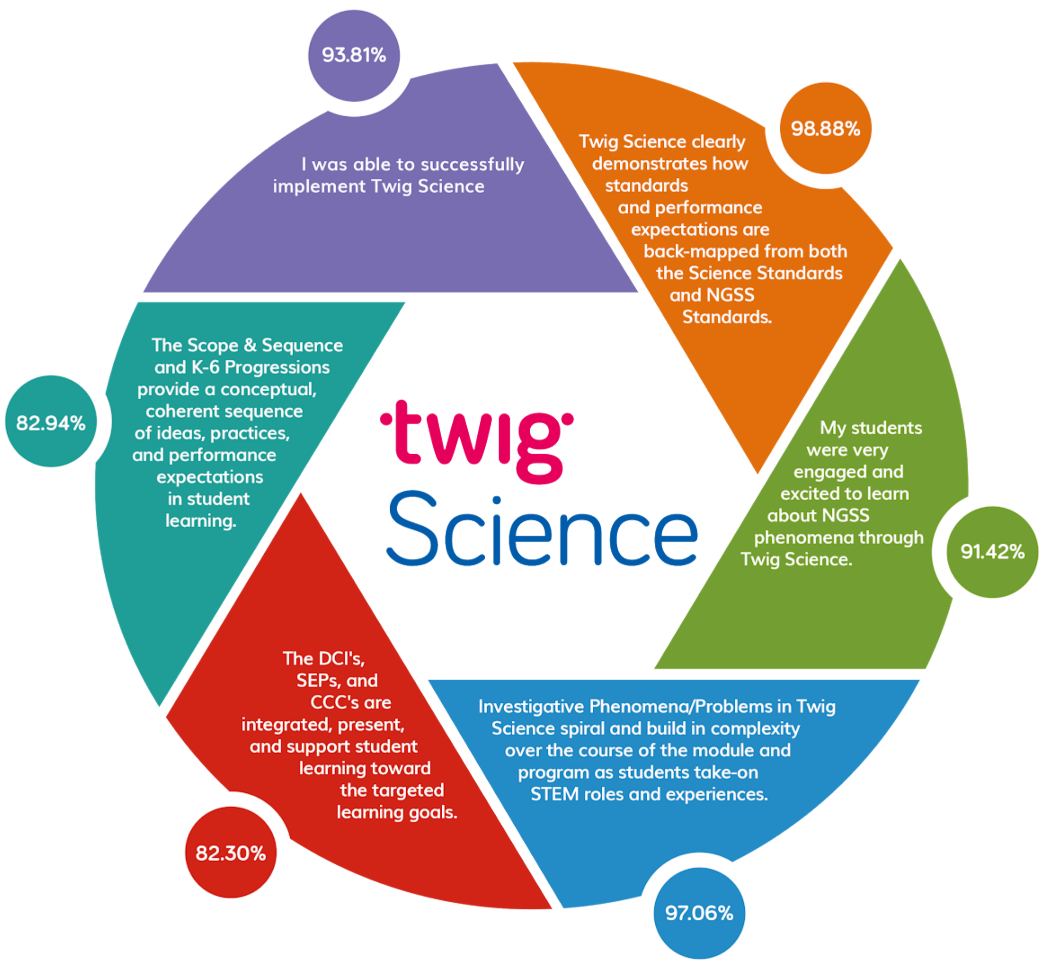
Hattie, John & Yates, G.C.R.. (2013). *Visible Learning and the Science of How We Learn*.

Hattie Effect Size: https://visible-learning.org/hattie-ranking-influences-effect-sizes-learning-achievement/

EEF Report:
https://educationendowmentfoundation.org.uk/tools/guidance-reports/improving-secondary-science/

Usage and User Feedback

User Data: September 1, 2019 - December 31, 2019
Users: 25,783
Districts: 33



Top three strengths as selected by survey respondents:

1. Support students in learning through authentic and meaningful phenomena or design problems., support student learning across the 3-dimensions, make student thinking visible, promote reasoning, sensemaking, and problem solving; challenge student thinking; and develop metacognitive abilities.
2. Monitor student learning and progress over time, Make decisions about instruction and provide feedback to students., Variety of Measures to elicit full range of student thinking and multiple assessment opportunities so students can demonstrate their understanding
3. Background information about phenomena, problems and NGSS, Module Introduction Videos, Model Lesson Videos, In-Person Guidance, Modeling and/or Support

ActIVa Learning IQWST®

PUBLISHER' S BACKGROUND INFORMATION

January 2020

Activate Learning is dedicated to promoting science literacy and achievement through three essential principles:

- Engage students with authentic learning and phenomena that are relevant and meaningful.
- Inspire teachers with research-based curricula that support three-dimensional learning.
- Prepare students for STEM careers of tomorrow.

Designed for the Next Generation Science Standards

IQWST® (Investigating and Questioning our World through Science and Technology) was developed through grant funding from the National Science Foundation. The development team, with combined expertise in science education, literacy education, and the learning sciences was led by Principal Investigators Joe Krajcik, Ph.D. (Michigan State University), Brian Reiser, Ph.D. (Northwestern University), LeeAnn Sutherland, Ph.D. (University of Michigan), and David Fortus, Ph.D. (Weizmann Institute of Science). At IQWST's foundation is research on how students learn and how they learn science in particular, the very research on which *A Framework for K-12 Science Education* and the Next Generation Science Standards are also based.

As research indicates, and as the *Framework* and the NGSS describe, students learn best when they use coherent materials that support them in building understanding over time.
IQWST® Integrated Edition engages students in scientific practices as they experience, investigate, model, and explain phenomena while learning core ideas and engaging with crosscutting concepts. Students build understanding by connecting ideas from lesson to lesson, from module to module, and across grades. Students also pursue their own original questions in modules that integrate the fundamentals of Physics, Chemistry, Life, Earth and Space Sciences, and Engineering.

The Core Tenets of the IQWST curriculum are:

Three-dimensional: Every learning sequence engages students with all three dimensions of the Next Generation Science Standards. For teacher planning purposes, Performance Expectations are identified at the beginning of each IQWST lesson, and all three components of three-dimensional learning are identified at the beginning of each activity.

1. **Disciplinary Core Ideas (DCI)** are typically addressed in multiple lessons, with the aim of developing depth of understanding rather than simply achieving coverage.
2. **Scientific and Engineering Practices (SEP)** engage students meaningfully in the work of scientists as they explore and learn core ideas.
3. **Crosscutting Concepts (CCC)** thread throughout the curriculum so that students construct deep understanding of the ideas as they apply to each science discipline.

Phenomena-driven: Students experience phenomena firsthand where possible, secondhand where not possible, but always so that the goal of science learning is to be able to explain phenomena-to explain *how* and *why* things in the natural world happen as they do.

Coherent: Students build understanding through a progression within each grade and across grade levels, learning critical DCIs, CCCs, and SEPs across content areas. Curricular coherence-revising and building on ideas across time-provides students with opportunities to develop, reinforce, and apply their understandings on an ongoing basis.

Student-centered: Students' original questions are at the core of the curriculum, elicited by an anchoring phenomenon, setting them on a quest to find answers that motivate learning across time.

Discourse-centered: Combining small-group and whole-group discussion in every lesson, supported by tools including a Driving Question Board and a Word Wall, students have multiple opportunities to use the language of science. Talk is used to share ideas, to think together, to problem solve, and to make sense of in-class science, everyday experiences, and the larger world.

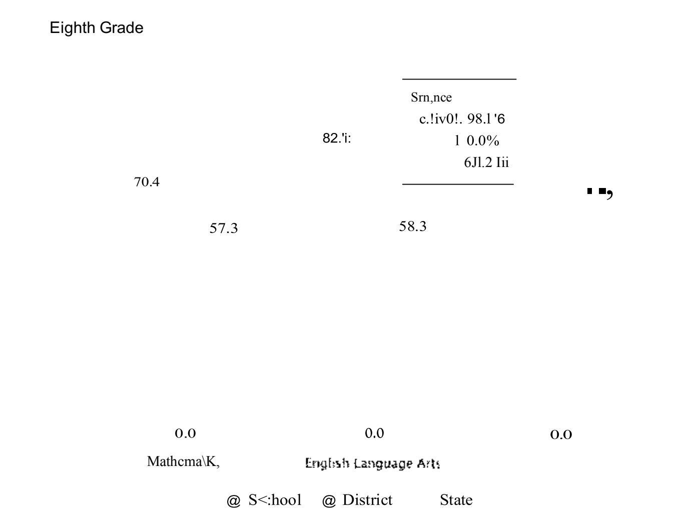
For all: IQWST engages *all* students with shared phenomena, common investigations, and opportunities to connect their everyday life experiences with science content. As students read, write, and talk about their experiences in a language-rich environment, every student has an opportunity to achieve success.

Joe Krajcik, Ph.D., a developer of the NRC Framework, NGSS, and IQ\VST, presents around the country on what n1akes teaching with three-dimensional learning different. ,Joe states: *"Perhaps the most significant shift in the Framework for K-12 Science Education and NGSS is the students need to make the sense of phenomena or design solutions for proble ms by scientific and engineering practices, disciplinary core ideas, and crosscutting concepts working together.* 171e *working together of the three dimensions to make sense of phenomena and design solutions toproblems* is *referred to as three-dimensional leaming. M aking sense of phenomena and designing solutions drives the teaching and leaming process . ... The Fra mework and NGSS, based upon the reseorch literature, clearly point out that you cannot learn scientific content (core ideas and crosscutting concepts) separate from engaging* in *practice. We learn content by engaging* in *practices and we learn practice by using science content to make sense of phenomena or design solutions toproblems. "*

Evidence of Efficacy

Students using JQWST in middle school classrooms across the country have demonstrated growth and excellence in standardized tests. Here are a few examples:

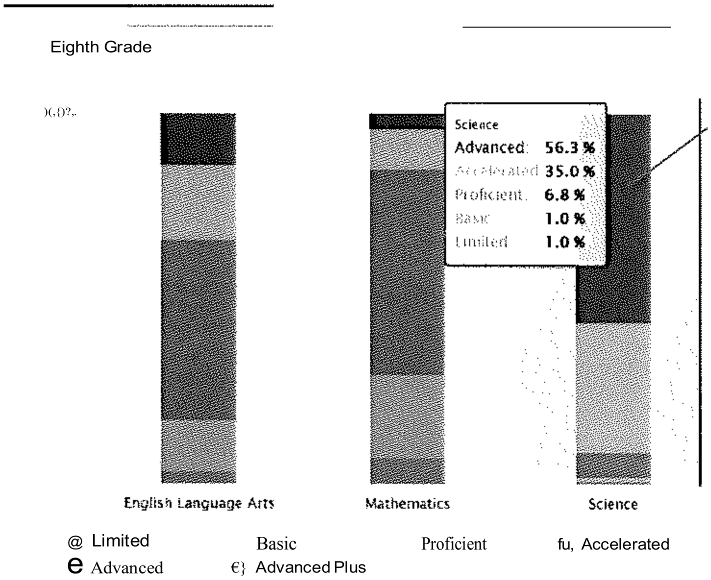
2018 8th Grade State Science Assessment
STEM School, OH
Implemented IQWST in 2010-2011
Source: Ohio Department of Education, Ohio School Report Card



This chart comparas the school to tis dislnct and to 1ha state as a whole for each test

98.1% of IQWST students passed the 8th Grade Science Assessment

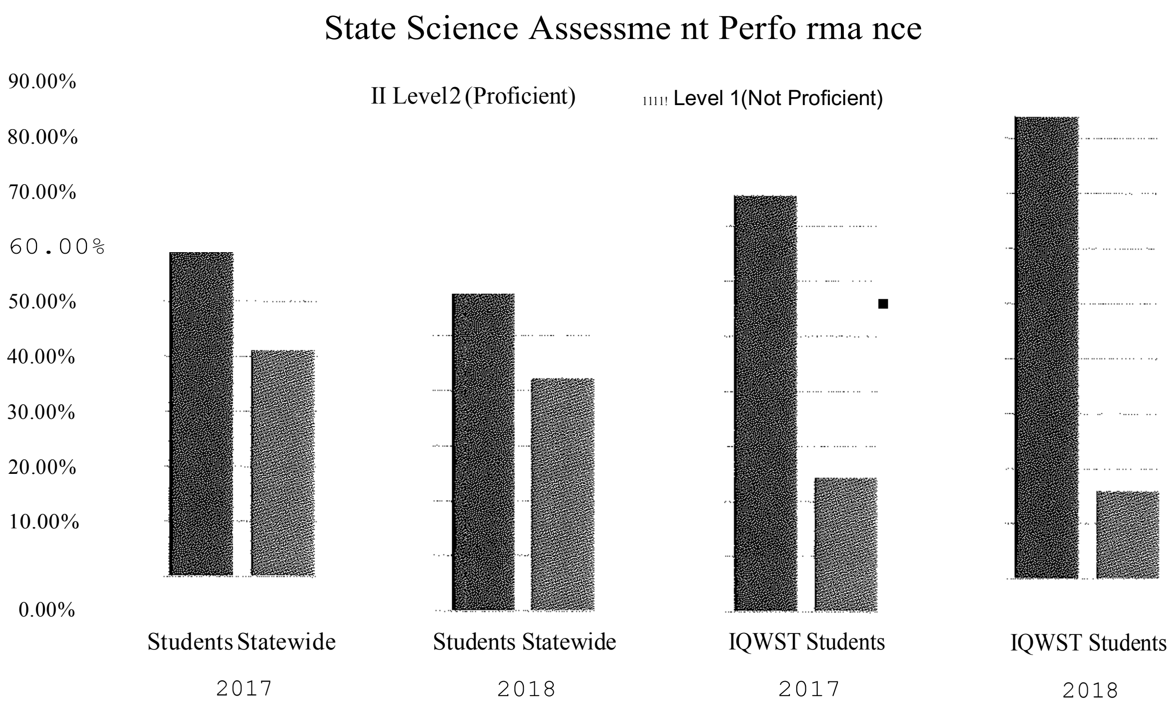
Almost 30% higher than the state average



Over 90% of IQWST students passed with Advanced or Accelerated scores (>80%)

2018 Student Growth
Suburban Midwest District

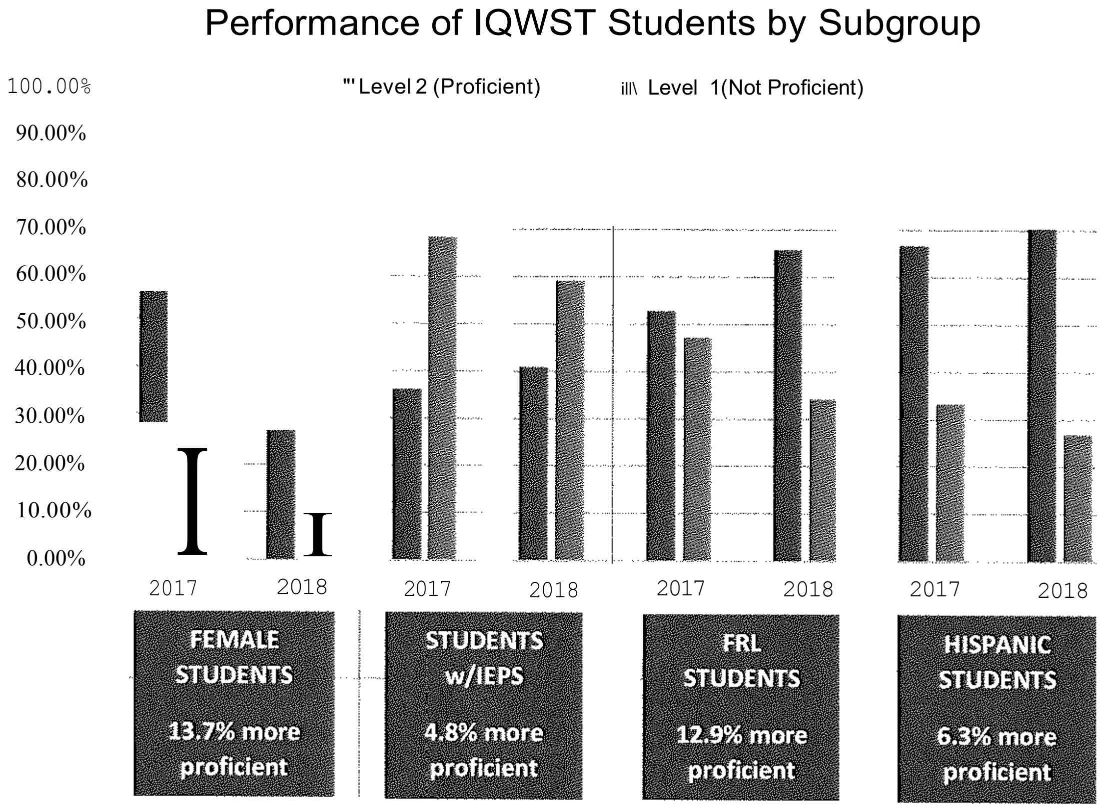
Middle school science teachers taught IQWST in 2017 and 2018. While average performance of gth graders on the state science assessment *decreased* slightly, scores for IQWST students *increased* during the same period.



Percentage of students who measured proficient <u>decreased</u> by 1.2%

IQWS illistullents' scores ii ea ii wittiB,II% more 101icientstuilents

Disaggregated data of the same district shows improved performance of IQWST students by population subgroup.



District Profile: 15% FRL, White 62%, Hispanic 31%, Black 3%, and the remaining 4% of the student population identifies as either Asian, American Indian, Pacific Islander, or a combination of two or more races.

2019 Science Pilot

Large Northwest School District

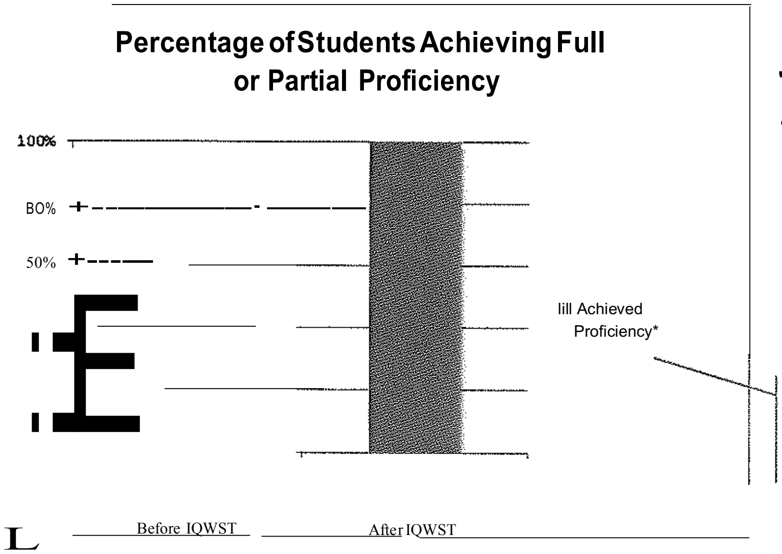
This district's middle schools piloted 3 science programs. Students were given pre- and post-assessments scored on a scale of 1(Developing) to 4 (Highly Proficient). Students in the IQWST pilot showed the largest growth with an average of 1.27 points higher on the post-test.

	IQWST (395 students)	**Curriculum B** (328 students)	**Curriculum C** (486 students)
Average Change to Scores from Pre- to Post-assessment	**1.27**	1.09	.92

Anecdotall y, 70% of students in the IQWST pi/at voted to adopt IQWST compared to 48% and 59% for Curricula B and C*, respectivel y.*

Student Growth Data on IQWST Unit {PS2: Energy)
Middle School, OR

Students from 2 classes demonstrated growth i n profici ency th roughout the course of the u nit as demonstrated by Pre- a nd Post-assessment data. *



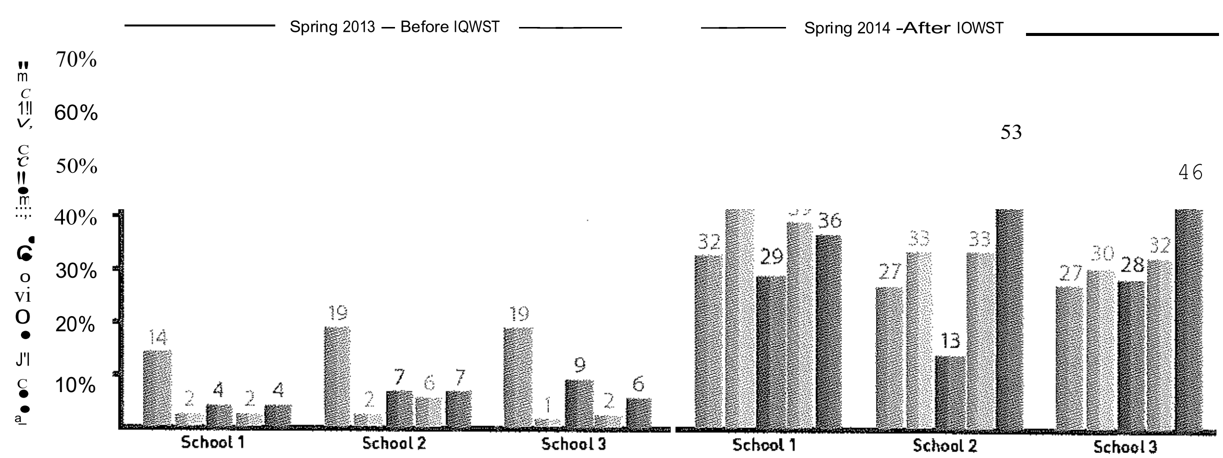
- 73% of students are at or above a proficient level.
- 27% are partially proficient at grade level.
- After the unit 0% are below proficient at grade level.

Score	Bel ow Proficient 1	Partially Proficient 2	Profi ci ent 3	Advanced 4
Pre	95%	5"/o	0%	0%
Post	0%	31%	55%	14%

100% of IQWST students demonstrated growth

College Readiness Results After IQWST Implementation

Three diverse middle schools, 1000 students, before & after implementation of IQWST.



Science College Readiness Standards:

Select two or more pieces of data f rom a simple data presentation.
i Understand bask scientific terminology.
R Find basic information in a brief body of text.
Determine how the value of one variable changes as the value of another variable changes in a simple data presentation.
II Understand the methods and tools used in a simple experiment.

••Mastery is defined as correctly answering at least 3 out ol 4 question5 aligned to tile standard.

Supplemental Services to Support Implementation

PROFESSIONAL LEARNING

The goal of Professional Learning for teachers is, of course, improved student learning! Research indicates that to improve student outcomes, Professional Learning must enable teachers to experience the curriculum firsthand, which is why in-person PD is always our priority.

In-school Professional Development

Our dedicated Professional Learning team works with districts to develop and execute successful implementation plans. Our consultants are award-winning educators who have taught the curriculum. Sessions engage teachers in a series of activities, focusing on how the instructional sequence uniquely supports students in building and applying science ideas, practices, and concepts over time.

Beyond face-to-face opportunities, we also offer virtual support options:

./ Supplementary Support Webinar
./ Q&A with a Curriculum Expert
./ IQWST Teacher Portal Support Site
./ IQWST Facebook Group
./ Lesson and Materials Setup Videos

STORYLINES

Part of the intellectual richness and rigor of IQWST is the challenge it provides as students connect ideas across modules. IQWST's storyline approach uses a Driving Question as the project or problem around which each module is built. That is, students build understanding of DCIs, CCCs, and SEPs in a coherent manner from one lesson to the next, with each activity raising a new question or a not-yet-solved problem that is addressed in the following activity. Hence, from a student perspective, a story is built from activity-to-activity, and lesson-to-lesson within each module, with the aim of answering the Driving Question in a complete, evidence-based explanation. In addition, the curriculum is designed such that each module connects to the one before it, providing a yearlong storyline to support student sense making across the entire school year. For teachers, the Storyline for each unit provides a detailed synopsis of each activity, serving as a both guideline and outline to support teachers in planning for and assessing learning.

DIFFERENTIATED INSTRUCTION

IQWST provides teachers with instructional supports and strategies to accommodate gifted and struggling students. These include:

./ Research-based general strategies described in the *JQWST Overview*

./ Lesson-specific strategies embedded in the Teacher Edition

./ Literacy strategies built into the readings

./ Audio versions of readings

./ Strategies modeled in PD

./ Biographies/Career Narratives that enables students to see themselves in STEM

./ IQWST Teacher Portal Support Site

./ IQWST Facebook Group

./ Spanish Student Editions for EL students

DEDICATED SUPPORT TEAM

Our team of experienced Product and Customer Support Specialists are ready to resolve any questions or technical issues in a timely manner.

Description and Evaluation of K-8 Current Science Program

Summary

Elementary

a. **Time spent on science**

Currently, one hour of instructional time on science is allocated in our Elementary Schedule and Structure Agreements at Beaverton elementary schools. This is approximately half the instructional time compared to the Oregon average of 1.9 hours/week and 2.3 hours/week nationally. Additionally, the majority (70.8%) of our elementary teachers reported on our 2018 survey that they do not have enough time to teach science. Only 16% of teachers reported spending more time on science than is scheduled per week (1 hour). 6% of Beaverton teachers reported they do not teach science. To increase time on science, the T&L team is reviewing the Beaverton Elementary Schedule and Structure Agreements document to make a recommendation that both addresses the need for an increased amount of time on science, and also better communicates about and supports teachers in integrating instruction across disciplines.

b. **Teacher preparedness**

According to our 2018 teacher survey, only 31% of Beaverton elementary teachers agree or strongly agree that they have the training they need to teach science. Since the last adoption, only optional training on the NGSS standards has occurred. Beaverton elementary teachers will need support in understanding the NGSS, the instructional shifts the NGSS call for, and the newly adopted instructional units.

c. **Adequacy of materials**

According to our 2018 teacher survey, the majority of teachers (66%) reported they do not have the materials they need to teach science. Additionally, teachers have reported great difficulty in managing the materials we do have when they are rotated between schools, as has been past practice. The Project Team has recommended that the adoption include kits for every teacher, to ensure that teachers can collaborate within their grade level teams and teach on the same schedule. This will also minimize teacher stress that would be caused by kit rotations.

d. **Outcomes**

The outcomes of our elementary students in science are currently predictable by race/ethnicity, SES, special education, and ELL status. Since 2013, Beaverton students have shown little to no growth in science achievement (as measured by Grade 5 OAKS scores) across all demographics.

APP C

Middle School Science

e. Time spent on science

The amount of time on science across Beaverton middle schools ranges from 63 to 80 minutes. When the common middle school experience is implemented, this will likely change for most schools. The instructional resource being recommended for adoption (IQWST) has lessons that are technically planned for 50 minute class periods, but Beaverton teachers who piloted the curriculum reported that they needed more time than that to teach the lessons. This same finding was also reported by another district, Eugene, who has 5 years of experience implementing IQWST. A key part of NGSS-aligned and engaging instruction in science are the hands-on laboratory and engineering student experiences. Having longer class periods (60 minutes or more) is widely accepted as necessary to providing these hands-on experiences.

f. Teacher preparedness

In the spring 2018 district student survey, a series of questions was asked from the Portland Metro STEM Partnership's "Student Survey of Teacher Instructional Practices." This survey measures the following three key areas of instructional practice in STEM:

- **Centeredness -** Teachers facilitate active engagement of students in their learning.
- **Relatedness -** Teachers implement learning activities that students find to be relevant, important, worthwhile, and connected to their cultural and personal lives
- **Assessment -** Teachers use frequent formative assessments (and summative assessments) to facilitate diagnostic teaching and learning.

The district average scores for each above areas were 2.1, 2.4, and 2.0 respectively. These scores correspond to a likert scale where 2 is "seldom/not often" and 3 is "sometimes." These scores were lower than the high school results and reflect a need for professional development and resource investment in all three of these key instructional areas, especially regarding the centeredness and formative assessment categories, which scored closest to the "seldom/not often" score. For more information on this survey see the end of this appendix.

a. Adequacy of materials

Current middle school materials are inadequate in multiple areas. All schools have reported insufficient funds to purchase both consumable supplies for hands on experiments and durable equipment to do sufficient and rigorous experiments. Many schools are short on basic supplies such glassware and engineering equipment. Additionally, all middle schools lack the probeware they need for students to collect quality data. In regards to other instructional resources, middle school has some, but not a complete set, of common assessments and assessment banks. Additionally, we do not have a full set of resources that meet the NGSS. Teachers across the district have developed various materials on their own, in collaboration, and with our previous adoption (CPO and PBIS), but with the last adoption being incomplete and teachers having little cross-district collaboration time, the materials being used across the district vary widely. New teachers have frequently reported difficulty in creating or finding materials in the absence of a complete district curriculum. Dual language science teachers do not have access to a full Spanish curriculum. Teachers have also reported that it is difficult to create common assessments or share materials due to a lack of common curriculum and collaboration time.

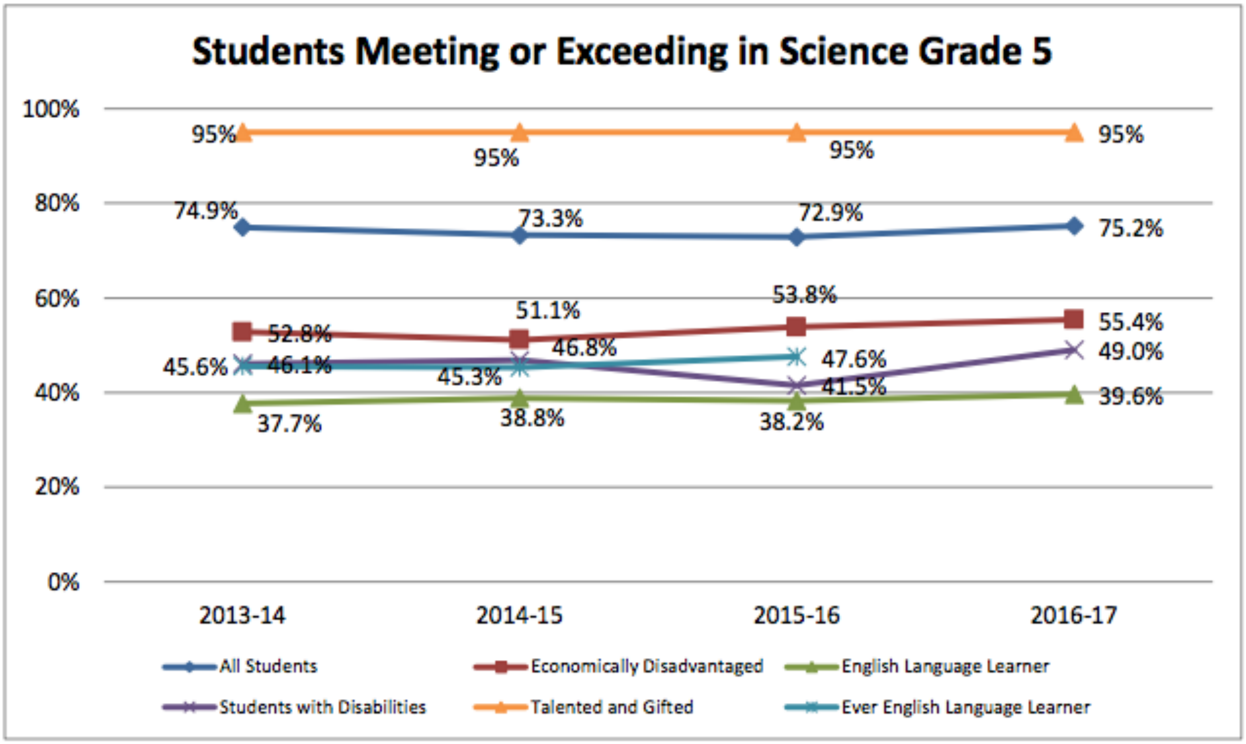
b. Outcomes

Overall, just under 50% of students are college and career ready in science as measured by the most recent Aspire test (2016-17). This number was relatively unchanged in the preceding 5 years as measured by the similar Explore test. These same outcomes are also predictable by race/ethnicity, SES, special education, and ELL status. Since 2013, Beaverton students have shown little to no growth in science achievement (as measured by Grade 8 OAKS scores, Aspire, and Explore data) across all demographics.

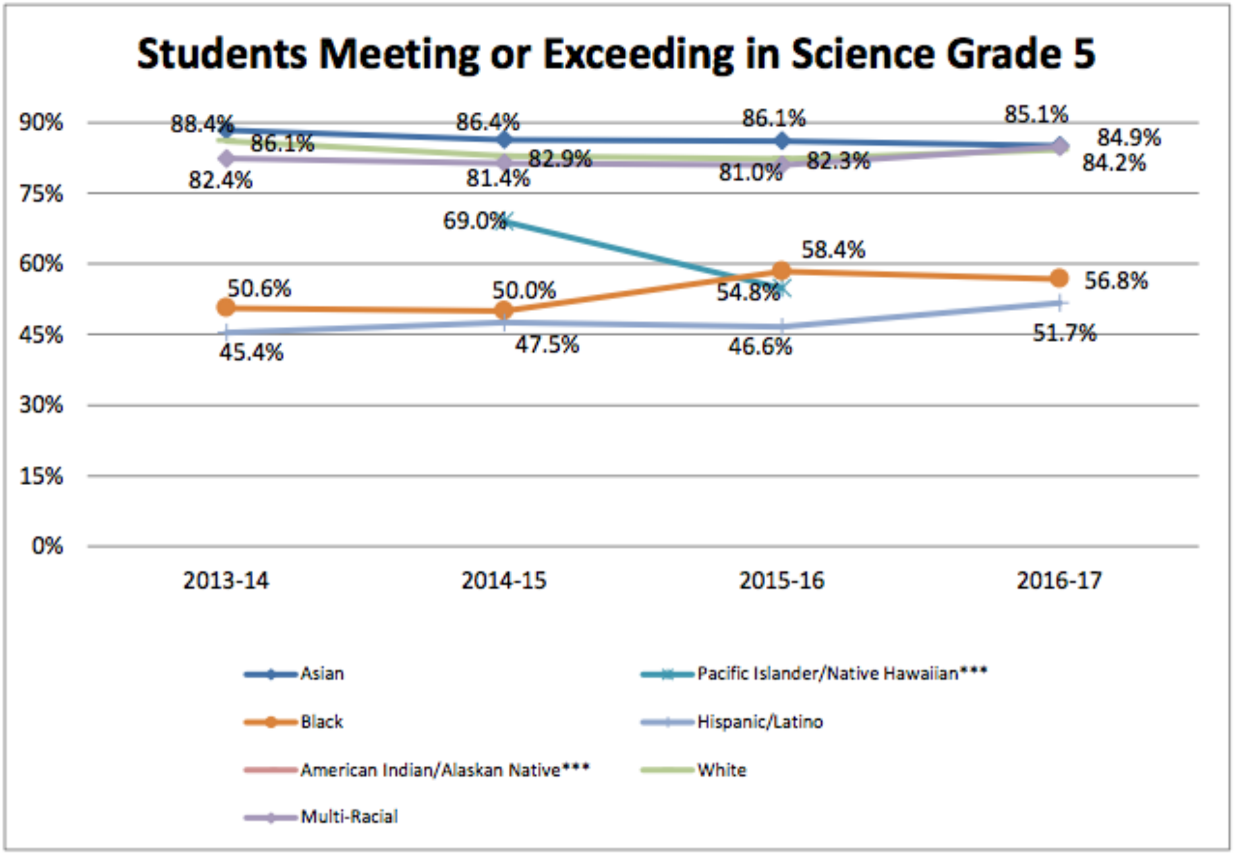
Evaluation of Current Program - Science Adoption

Science Achievement Scores

Grade 5 - Grade 5, 8, and 10 reports on Meeting and Exceeding in science are taken from the [board packet for 2/6/18 meeting.]()



APP C



Students Meeting or Exceeding Standard in Science, Grade 5	2013-14	2014-15	2015-16	2016-17
All Students	74.9%	73.3%	72.9%	75.2%
Economically Disadvantaged	52.8%	51.1%	53.8%	55.4%
English Language Learner	37.7%	38.8%	38.2%	39.6%
Ever English Language Learner	45.9%	45.6%	45.3%	47.6%
Students with Disabilities	46.1%	46.8%	41.5%	49.0%
Asian	88.4%	86.4%	86.1%	85.1%
Pacific Islander/Native Hawaiian***		69.0%	54.8%	
Black	50.6%	50.0%	58.4%	56.8%
Hispanic/Latino	45.4%	47.5%	46.6%	51.7%
American Indian/Alaskan Native***				
White	86.1%	82.9%	82.3%	84.2%
Multi-Racial	82.4%	81.4%	81.0%	84.9%
Talented and Gifted	99.1%	98.8%	99.1%	98.9%
Male	75.3%	73.6%	73.5%	75.7%
Female	74.5%	73.1%	72.2%	74.6%

School Name	2013-14	2014-15	2015-16	2016-17
Aloha-Huber Park K-8 School	47.9%	50.4%	46.9%	50.8%
Barnes Elementary School	51.6%	50.0%	52.2%	51.7%
Beaver Acres Elementary School	57.5%	50.0%	52.2%	45.4%
Bethany Elementary School	92.8%	86.1%	82.1%	91.3%
Bonny Slope Elementary School	93.9%	90.2%	80.6%	89.7%
Cedar Mill Elementary School	79.1%	90.9%	98.0%	>95%
Chehalem Elementary School	58.5%	80.0%	67.1%	71.6%
Cooper Mountain Elementary School	87.5%	88.0%	88.9%	82.3%
Elmonica Elementary School	72.3%	77.3%	60.3%	62.3%
Errol Hassell Elementary School	89.6%	87.3%	87.2%	90.0%
Findley Elementary	94.7%	93.5%	95.0%	93.6%
Fir Grove Elementary School	62.8%	55.4%	65.1%	70.7%
Greenway Elementary School	62.7%	66.7%	64.1%	60.0%
Hazeldale Elementary School	73.2%	60.3%	73.1%	67.8%
Hiteon Elementary School	91.6%	85.7%	86.4%	79.8%
Jacob Wismer Elementary School	87.2%	88.6%	91.1%	>95%
Kinnaman Elementary School	50.0%	46.7%	47.7%	43.2%
McKay Elementary School	65.6%	65.5%	71.9%	81.1%
McKinley Elementary School	53.9%	47.7%	60.2%	59.4%
Montclair Elementary School	88.2%	89.7%	90.0%	>95%
Nancy Ryles Elementary School	84.1%	82.2%	79.3%	77.9%
Oak Hills Elementary School	87.1%	97.4%	89.5%	87.8%
Raleigh Hills K-8 School	72.4%	74.6%	64.3%	78.7%
Raleigh Park Elementary School	76.3%	71.9%	70.0%	69.2%
Ridgewood Elementary School	88.5%	81.0%	80.4%	86.8%
Rock Creek Elementary School	93.8%	90.9%	93.9%	88.3%
Scholls Heights Elementary School	89.0%	89.3%	86.1%	91.2%
Sexton Mountain Elementary School	86.6%	71.9%	78.6%	85.1%
Springville K-8 School	81.3%	82.1%	86.3%	85.0%
Terra Linda Elementary School	68.7%	73.6%	80.3%	74.0%
Vose Elementary School	56.3%	43.5%	42.9%	55.9%

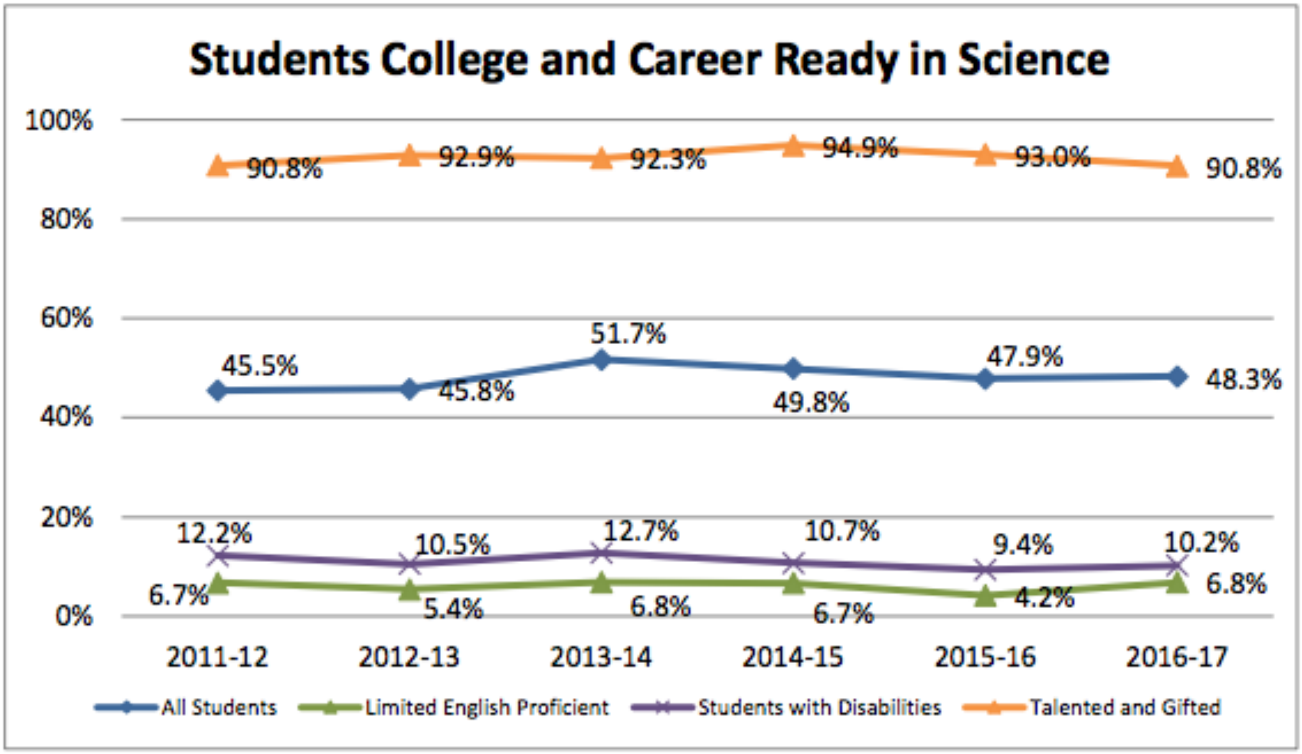
APP C

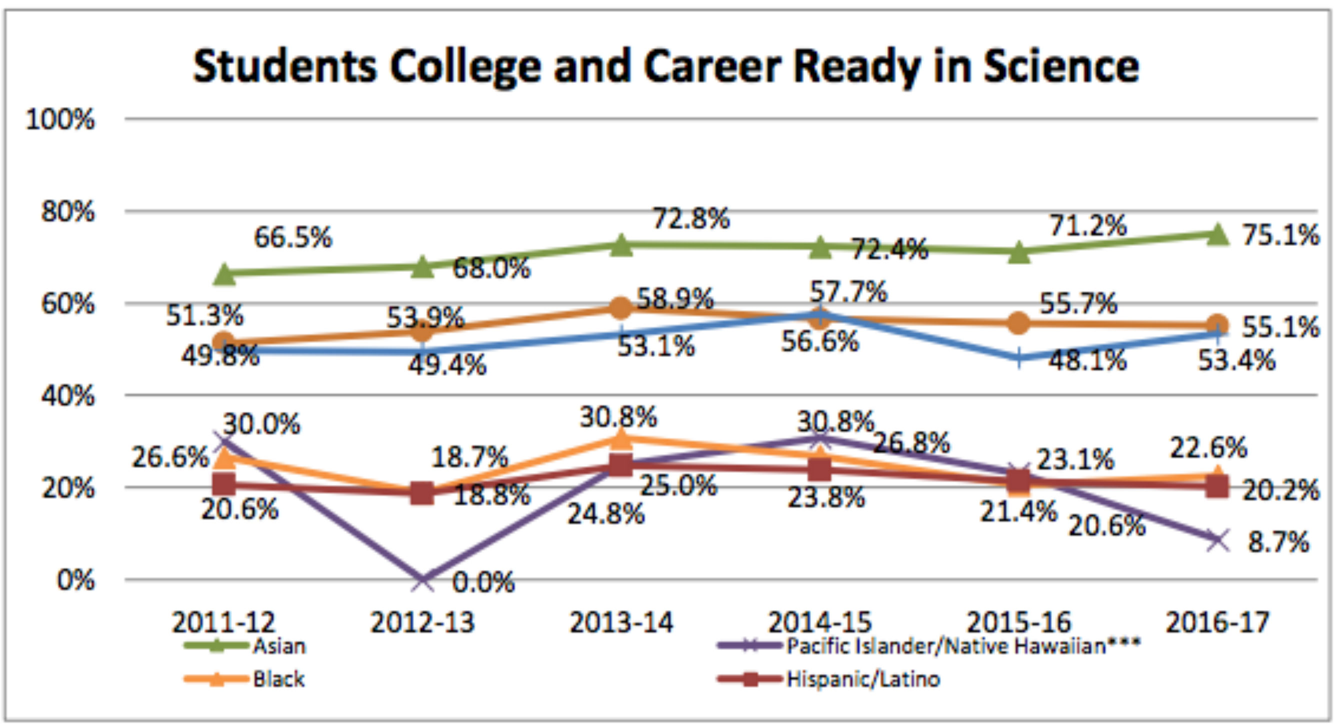
West Tualatin View Elementary School	81.1%	87.1%	76.5%	70.0%
William Walker Elementary School	40.2%	46.1%	45.6%	56.7%

Students Meeting or Exceeding Standard in Science, Grade 5 (2016-17)	All students	Asian	Hispanic /Latino	Multi-Racial	White	Female	Male	Econ Disadv	Stdnts with Disab	TAG	English Lang. Learner	Ever ELL
Aloha-Huber Park K-8	51%		49%		56%	51%	51%	45%			32%	42%
Barnes	52%		27%		85%	40%	67%	37%			22%	22%
Beaver Acres	45%		31%		59%	43%	48%	43%			26%	33%
Bethany	91%	91%			93%	88%	94%			>95%		
Bonny Slope	90%	91%			90%	90%	89%			>95%		
Cedar Mill	>95%				>95%	>95%	>95%			>95%		
Chehalem	72%		62%		81%	73%	70%	61%			42%	52%
Cooper Mountain	82%				84%	85%	79%					
Elmonica	62%		43%			60%	65%	51%			38%	44%
Errol Hassell	90%				95%	86%	94%					
Findley	94%	95%			89%	95%	92%			>95%		
Fir Grove	71%		52%		79%	61%	81%	61%				50%
Greenway	60%		36%		86%	68%	52%	50%			20%	27%
Hazeldale	68%		49%		80%	73%	62%	59%			41%	52%
Hiteon	80%				83%	88%	73%	71%		>95%		
Jacob Wismer	>95%	>95%			92%	94%	>95%			>95%		
Kinnaman	43%		30%		60%	36%	51%	39%			19%	27%
McKay	81%					86%						
McKinley	59%		42%		79%	54%	65%	50%			23%	30%
Montclair	>95%				95%	94%	>95%					
Nancy Ryles	78%				84%	64%	90%	68%		>95%		
Oak Hills	88%				90%	85%	91%			>95%		
Raleigh Hills K-8	79%		58%		91%	76%	82%	70%			56%	61%
Raleigh Park	69%				88%	59%	77%					
Ridgewood	87%				87%	86%	88%					
Rock Creek	88%				94%	86%	91%	62%		>95%		
Scholls Heights	91%				94%	96%	86%			>95%		
Sexton Mountain	85%				87%	85%	85%					
Springville K-8	85%	92%			84%	90%	78%	70%		>95%		64%
Terra Linda	74%				81%	75%	73%	52%				
Vose	56%		47%		82%	50%	62%	46%			38%	39%
West Tualatin View	70%				81%		70%					
William Walker	57%		56%			54%	59%	57%			43%	48%

Science: The achievement data for 5th grade Science increased 2.3%, from 72.9% of our students proficient or exceeding in 2015-16 to 75.2% of our students proficient or exceeding in 2016-17. There has been an increase in the percentage of students with disabilities who have demonstrated proficiency in science.

Grade 8 - Explore or Aspire Scores (% that meet or exceed)





Students College and Career Ready in Science, Grade 8	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
All Students	45.5%	45.8%	51.7%	49.8%	47.9%	48.3%
Economically Disadvantaged	[redacted]					
Limited English Proficient	6.7%	5.4%	6.8%	6.7%	4.2%	6.8%
Students with Disabilities	12.2%	10.5%	12.7%	10.7%	9.4%	10.2%
Asian	66.5%	68.0%	72.8%	72.4%	71.2%	75.1%
Pacific Islander/Native Hawaiian***	30.0%	<5%	25.0%	30.8%	23.1%	8.7%
Black	26.6%	18.8%	30.8%	26.8%	20.6%	22.6%
Hispanic/Latino	20.6%	18.7%	24.8%	23.8%	21.4%	20.2%
American Indian/Alaskan Native***						
White	51.3%	53.9%	58.9%	56.6%	55.7%	55.1%
Multi-Racial	49.8%	49.4%	53.1%	57.7%	48.1%	53.4%
Talented and Gifted	90.8%	92.9%	92.3%	94.9%	93.0%	90.8%
Male	44.7%	44.6%	50.3%	47.7%	45.7%	47.0%
Female	46.2%	47.2%	53.2%	52.1%	50.2%	49.7%

School Name	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Aloha-Huber Park K-8 School	14.9%	15.6%	22.0%	30.9%	14.5%	13.8%
Arts & Communication Magnet Academy	47.6%	41.2%	51.0%	58.9%	43.7%	43.5%
Cedar Park Middle School	47.6%	47.9%	51.0%	56.9%	51.8%	52.2%
Conestoga Middle School	45.0%	35.3%	51.3%	45.7%	35.7%	32.5%
Five Oaks Middle School	29.3%	32.9%	37.0%	29.4%	30.7%	33.7%
Health & Science School	45.7%	37.7%	60.0%	41.7%	39.2%	52.8%
Highland Park Middle School	43.4%	50.6%	50.0%	47.8%	43.0%	48.9%
International School of Beaverton	76.3%	70.6%	74.8%	75.6%	88.1%	83.0%
Meadow Park Middle School	49.8%	47.1%	54.7%	45.3%	51.9%	41.6%
Mountain View Middle School	29.0%	28.6%	38.2%	31.5%	27.7%	33.1%
Raleigh Hills Elementary School	52.5%	69.4%	62.7%	63.2%	51.6%	51.7%
Springville K-8 School		51.6%	55.8%	61.5%	66.7%	52.8%
Stoller Middle School	59.4%	67.0%	68.4%	69.4%	75.3%	72.9%
Whitford Middle School	44.4%	43.5%	46.9%	45.5%	35.2%	35.1%

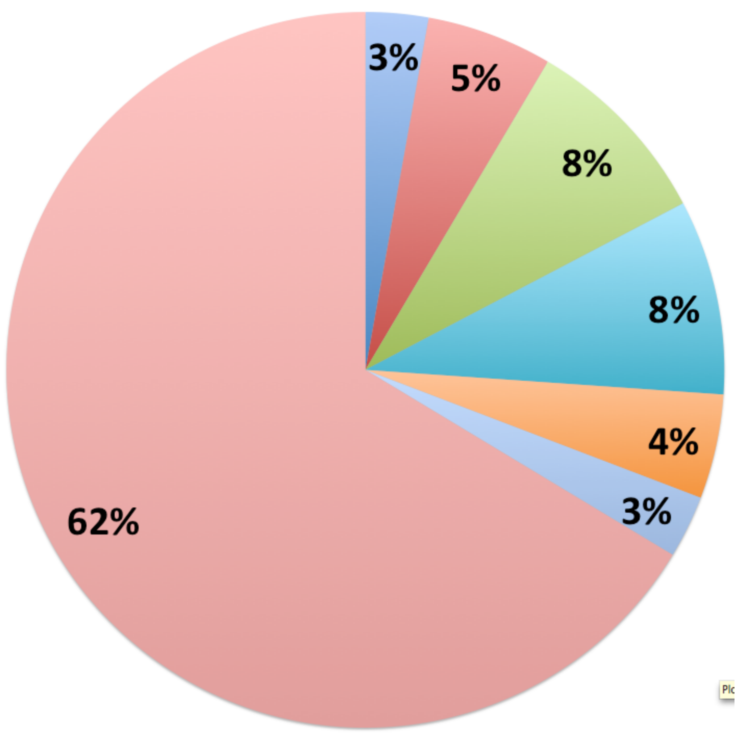
APP C

Students College- and Career-Ready in Science, Grade 8 (2016-17)	All students	Asian	Hispanic /Latino	Multi-Racial	White	Female	Male	Stdnts with Disab	TAG	English Lang. Learner
Aloha-Huber Park K-8	14%		7%			12%	15%			
ACMA	44%				49%	46%			83%	
Cedar Park	52%	94%	17%	67%	59%	55%	50%	19%	92%	
Conestoga	32%	47%	21%		33%	40%	26%	8%	64%	
Five Oaks	34%	54%	20%		45%	36%	31%	7%	83%	<5%
Health & Science	53%		25%		67%	47%	58%		93%	
Highland Park	49%	65%	24%	58%	56%	53%	45%	7%	91%	
ISB	83%	82%		86%	86%	81%	85%		>95%	
Meadow Park	42%	82%	11%	39%	54%	40%	43%	6%	94%	<5%
Mountain View	33%	40%	22%		41%	36%	30%	<5%	86%	
Raleigh Hills K-8	52%				68%	59%	45%			
Springville K-8	53%				62%	50%	56%			
Stoller	73%	84%	53%	74%	68%	71%	74%	19%	>95%	38%
Whitford	35%		9%		54%	44%	27%	7%	87%	<5%

Data from Elementary Survey on Science in Elementary Schools

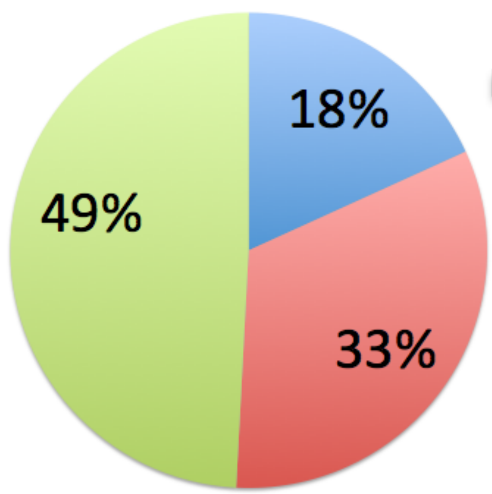
N = 344 teachers responded to the survey (there are about 800 elementary teachers in the district). Survey went out on 3.15.2018. Link to summary of survey responses in google form

Q1. What is your best guess on how many minutes a week you teach science, on average?



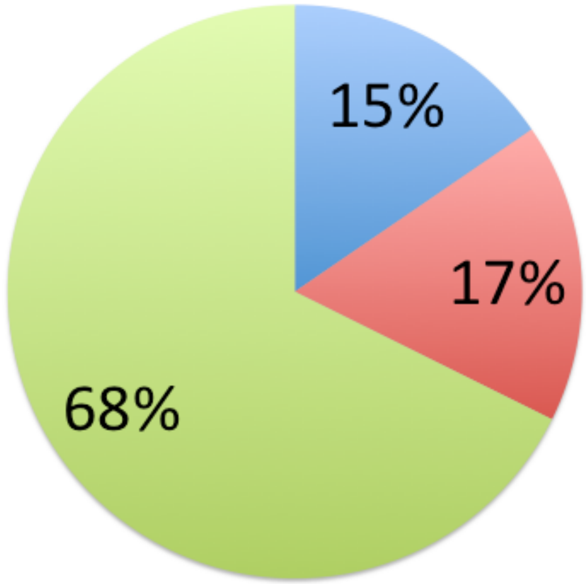
Color	% Response	Response Choice
	62%	It is hard for me to estimate how many minutes I teach science in a year because I do not teach science every week, I teach it in units that are spread throughout the year
	3%	0 - 15 minutes
	5%	15 - 30 minutes
	8%	30 - 60 minutes
	8%	60 - 90 minutes
	4%	90 - 120 minutes
	3%	I am a specialist, I am not expected to teach science

Q2. What proportion of content time do you spend on science as compared to social studies and health?



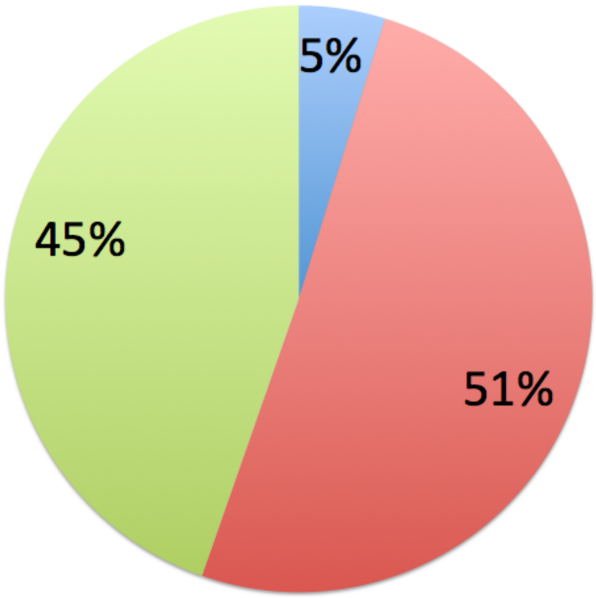
Color	% Response	Response Choice
	49%	I spend about the same amount of time on science as I do on social studies and health
	18%	I probably spend less time on science than I do on social studies and health
	33%	I probably spend more time on science than I do on social studies and health

Q 3: Is science grouped into your content time (ie. - is it grouped with health and/or social studies ?)



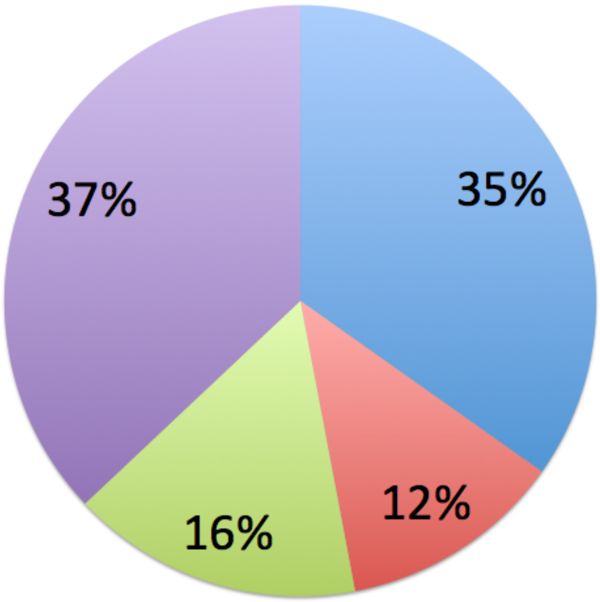
Color	% Response	Response Choice
	68%	Yes
	15%	Other
	17%	No

Q 4: Is your content time determined by your master schedule and created by your administrator?



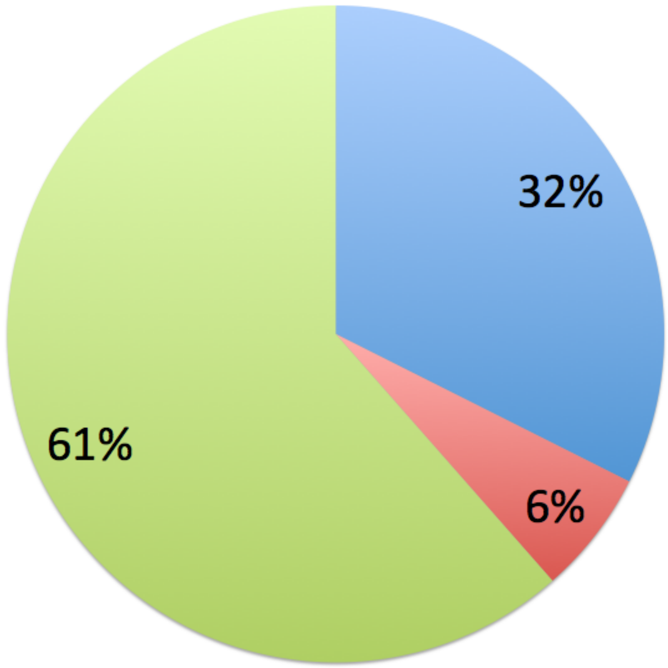
Color	% Response	Response Choice
	45%	Yes
	5%	I do not know
	51%	No

Q5: If your science time is scheduled for you, do you teach more, the same, or fewer minutes of science, on average, than is scheduled into your week?



Color	% Response	Response Choice
	16%	I teach more minutes of science than are scheduled
	35%	I teach about the same amount of minutes as are scheduled
	12%	I teach fewer minutes than are scheduled
	37%	Science is not scheduled into my day/week

Q6: If your science time is not scheduled, do you still teach science?

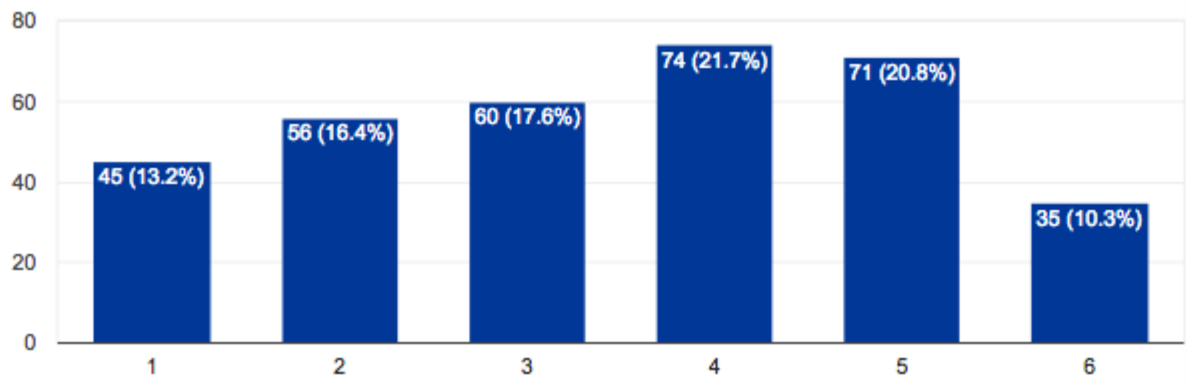


Color	% Response	Response Choice
	61%	Yes
	32%	Does no apply to me
	6%	No

The following questions were Likert Scale Questions

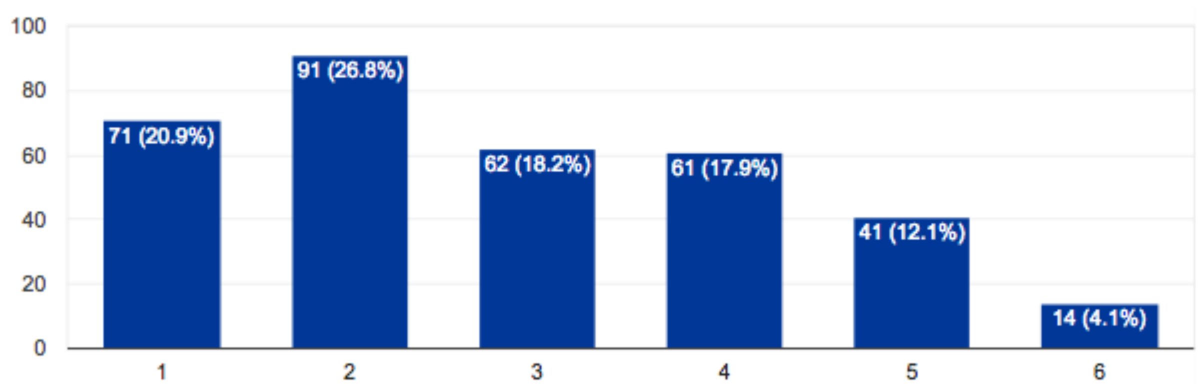
1	2	3	4	5	6
Strongly disagree	**Disagree**	**Slightly disagree**	**Slightly agree**	**Agree**	**Strongly agree**

Q7: I have had the training I need to teach science

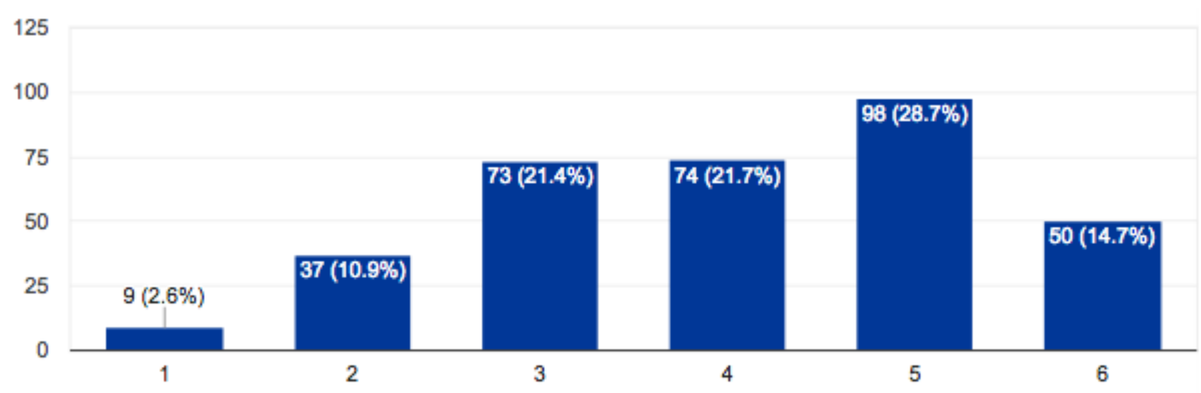


1	2	3	4	5	6
Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree

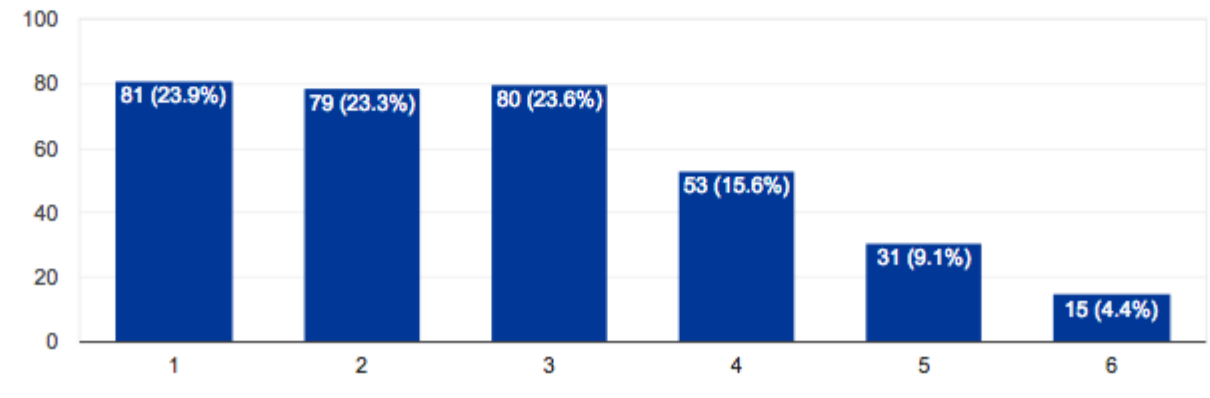
Q8: I have the materials I need to teach science



Q9: I feel confident about teaching science

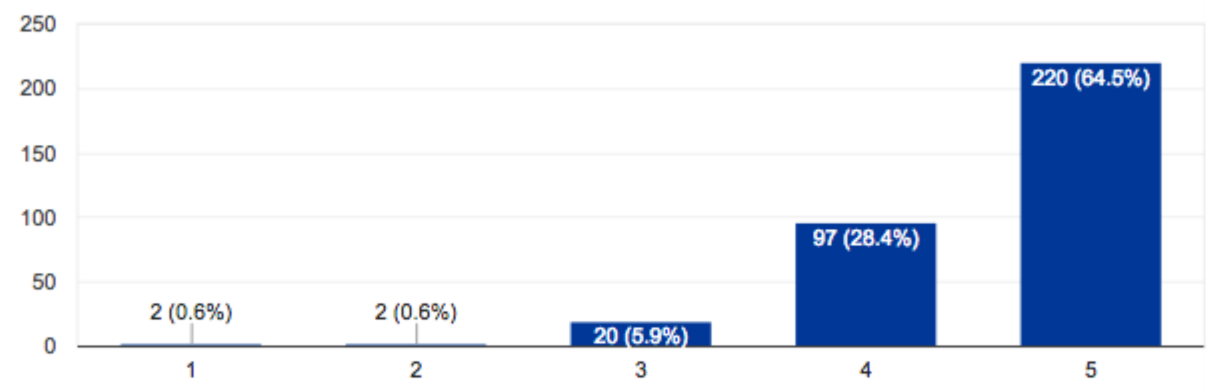


Q10: I have the time that I need to teach science

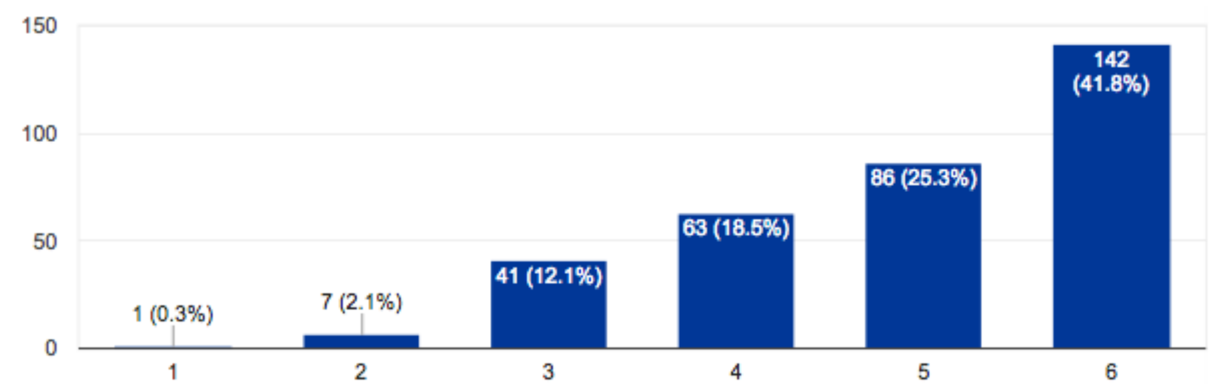


1	2	3	4	5	6
Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree

Q11: I think teaching science helps increase student engagement in my classroom



Q12: I think that teaching science helps ELL students with academic language acquisition.



Q13: Anything else that you would like us to know about science in elementary school?

Generalized Teacher Responses	Count
Too much focus on reading and math, not enough time for science. Blocked schedule makes it hard to find time for science	17
District resources are difficult to pair with PYP. Need materials that correlate to PYP units and are more integrated.	11
Want kits/science materials kept in schools (not dropped off). Liked Foss kits.	11
Do not like current materials/books. Do not like workbook.	9
Teaching in elementary needs to be more integrated (ie science/writing, science/math), not siloed	9
Want more PD/guidance on teaching science	8
When science is hands-on students are engaged (When only reading/writing - about science they are not, even best readers/writers)	5
Teaching Science is time and labor intensive. Need time for planning.	4
Create(d) own units	3
Spanish version of curriculum is a need/ ELL support needed	3
Give money for science to schools	2
Need elementary science TOSA.	2
Teachers still teaching old lessons they have always taught	1
Look at free materials before buying new materials	1
Create videos of master teachers teaching science	1
Use IA to teach science and technology	1
ELL/SPEd students pulled during science	1
Large class size makes teaching science difficult	1
Do not make science a workshop model	1
Admin is supportive of adding time for science	1

Middle School Student Survey Data

Student Survey of Instructional Practices:

The Student Survey of Instructional Practices was administered to all middle and high school students in the spring of 2018 to inform the adoption process. The survey is designed to measure three research-based instructional approaches that are considered to be the most influential on student achievement in STEM (Saxton, et al., 2014).

1. **Centeredness**
    - Teachers facilitate active engagement of students in their learning.
        - Teachers assume the role of facilitator rather than authority figure
        - Students assume the role of active learners making sense of learning activities for themselves

2. **Relatedness**
    - Teachers implement learning activities that students find to be relevant, important, worthwhile, and connected to their cultural and personal lives outside of the classroom and encourage students to actively use real-world examples in their thinking.

3. **Assessment**
    - Teachers use frequent formative assessments (and summative assessments) to facilitate diagnostic teaching and learning.
        - The teacher's role includes setting clear, developmentally appropriate learning targets or performance criteria and selecting or developing formative assessment tasks that align with learning goals
        - The student's role includes assuming ownership over their learning and engaging in metacognitive activities
        - Teachers and students both contribute to a classroom culture of assessment for learning

Why should educators use this survey?

The three instructional practices identified in this survey - facilitating active engagement of students in their learning, the use of assessment, and the implementation of culturally and personally relevant curriculum - have been shown by research to impact student achievement in STEM. However, because instructional practices are complex, it is not possible to use one tool to see the whole picture. In addition to using this survey, we encourage teachers to look at student work, listen to student talk, and collaborate with colleagues to reflect on how to best facilitate student-centered learning in the classroom.

What kinds of questions or statements are on the survey?

Below are examples taken from the survey. Students are asked to indicate their answers from 1 (Almost never) to 5 (Very often).

- My teacher asks questions that have more than one answer.
- My teacher asks me to give reasons for my answers.
- My teacher encourages me to ask questions.
- I talk to my classmates about how to solve problems.

How can the results be used to improve outcomes for students?

The data is intended to be used at the individual teacher level to inform decisions that help educators create student-centered, relevant and meaningful learning experiences in STEM. The Portland Metro STEM Partnership, our STEM Hub, developed this survey. A sample

PORTLAND METRO STEM PARTNERSHIP

Brown Elementary School
Student Survey of Teacher Instructional Practices
Results for the Academic Year 2015-2016
Science
Teacher Report for Mary Jones

Almost never 1	Seldom/Not often 2	Sometimes 3	Often 4	Very often 5

	Questions by Category	**Example Data**
	Question In science class, …	
Centeredness	My teacher asks questions that have more than one answer	3.4
	My teacher asks me to give reasons for my answers	4.1
	My teacher encourages me to ask questions	3.6
	My teacher encourages me to talk to my classmates about how to solve problems	3.6
	I memorize facts and science principles for no reason.	3.6
	My teacher spends a lot of time talking to the whole class.	2.2
	My teacher has me work with my classmates to learn.	3.7
	My teacher asks me to use evidence from classroom experiences, reading, group work, or other learning to support my answers.	3.6
	My teacher has us read from lots of printed material.	2.9
	Centeredness Mean =	***3.4***
Relevance	We relate what we are learning to our daily lives	3.2
	We connect what we are studying to current events or real-world problems	3.4
	I don't see a connection between what we are studying and my life outside of school*	3.4
	My teacher encourages me to use real-world examples in my thinking	3.6
	I don't think what we are studying is important outside of school*	3.8
	I think what we are learning is related to my life outside of school	3.3
	Relevance Mean =	***3.5***
Assessment	My teacher provides feedback on how I am doing.	*3.4*
	My teacher helps me understand my work so I can do better	*4.2*
	I understand what is expected of me.	*4.0*
	My teacher clearly explains what I should be learning.	*4.2*
	My teacher only gives us tests at the end of the unit we are studying.	*1.8*
	If I do not understand something during science time, I know I'll have a chance to ask questions about it.	*3.9*
	Assessment Mean =	***3.6***

Overall Mean =	***3.5***

Results of the above survey (2018): On average, high schools performed stronger on this survey, across all three categories, than middle schools.

MS 2018 Spring Student Survey of Teacher Instructional Practices in Science - Category Means				
School		**Centeredness**	**Relevance**	**Formative Assessment**
Cedar Park	Mean	2.2	2.4	1.8
	N	124.0	123.0	121.0
	Std. Deviation	0.9	1.0	0.8
Conestoga	Mean	2.4	2.8	2.3
	N	313.0	304.0	310.0
	Std. Deviation	0.7	0.9	0.9
Five Oaks	Mean	2.0	2.2	1.8
	N	225.0	222.0	225.0
	Std. Deviation	0.7	0.9	0.8
Highland Park	Mean	2.1	2.4	1.9
	N	190.0	185.0	190.0
	Std. Deviation	0.8	1.0	0.9
Meadow Park	Mean	2.1	2.5	1.9
	N	169.0	167.0	169.0
	Std. Deviation	0.8	1.0	0.8
Mountain View	Mean	2.3	2.4	1.9
	N	205.0	197.0	200.0
	Std. Deviation	0.8	1.0	0.8
Stoller	Mean	1.8	2.2	1.7
	N	494.0	483.0	493.0
	Std. Deviation	0.7	0.9	0.8
Whitford	Mean	2.2	2.5	2.5
	N	196.0	192.0	195.0

	Std. Deviation	0.8	0.9	1.0
District Mean	Mean	**2.1**	**2.4**	**2.0**

Elementary Time Research Summary

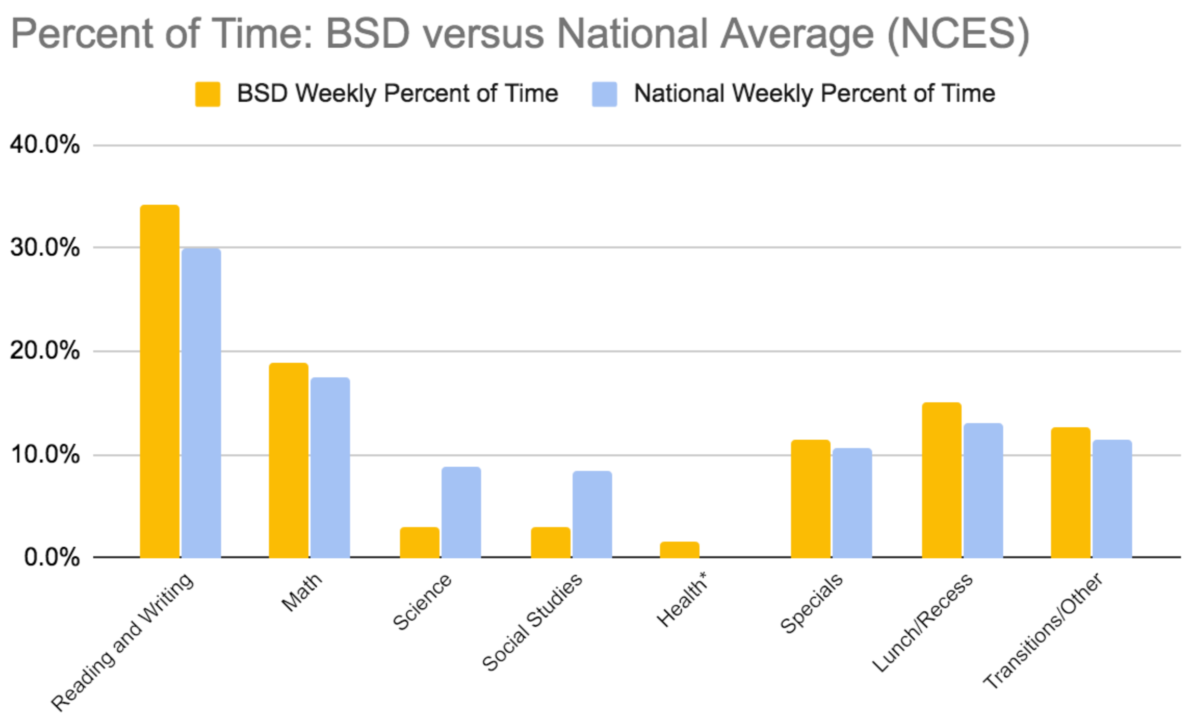
The State of Instructional Time: Beaverton versus National Averages

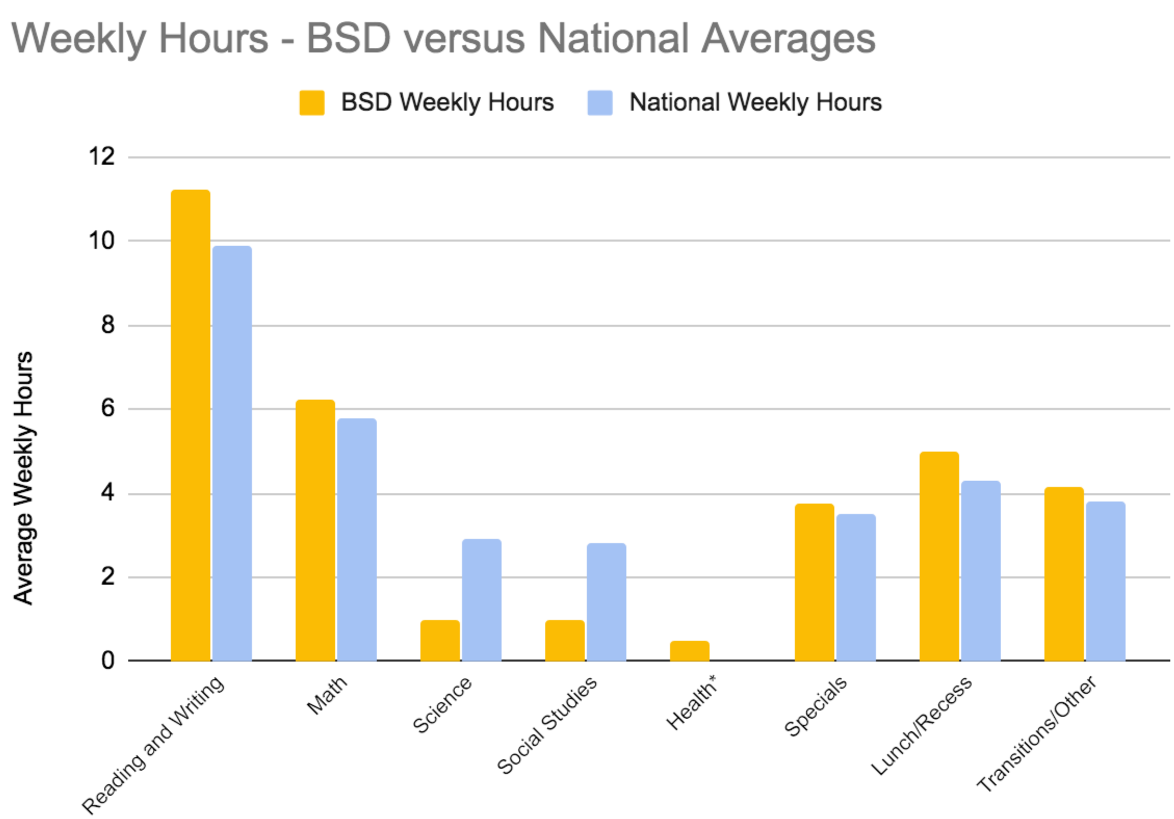
The below tables and graphs compares the amount of time students in Beaverton spend on each instructional area or activity per day and week as compared to national averages. Source: NCES study published by the US Department of Education in 2017.

	BSD Instructional Time (Averages)			Average Instructional Time Nationally (NCES)	
	Daily Minutes	**BSD Weekly Hours**	**Percentage of Time**	**National Weekly Hours**	**Percentage of Time**
ELA / Reading and Writing	135	11.3	34.2%	9.9	30.0%
Math	75	6.3	19.0%	5.8	17.6%
Science	12	1.0	3.0%	2.9	8.8%
Social Studies	12	1.0	3.0%	2.8	8.5%
Health*	6	0.5	1.5%	*	*
Specials (on average)	45	3.8	11.4%	3.5	10.6%
Lunch/Recess**	60	5.0	15.2%	4.3	13.0%
Transitions/Other	50	4.2	12.7%	3.8	11.5%
Total Time	**395**	**32.9**	**100.0%**	**33**	**100.0%**

*Health was not reported separately in the NCES study. Above, health should be assumed as part of "Other," to reach the total school time average per week of 33 hours nationally.

**For NCES data, assumption of daily lunch time of 30 minutes was added to the recess category in the study. Average recess only time was reported as 1.8 hours by NCES.
For the BSD Lunch/Recess, a 45 minute lunch/recess plus an additional 15 minute recess was assumed.


Percent of Time: BSD versus National Average (NCES)
BSD Weekly Percent of Time
National Weekly Percent of Time
40.0%
30.0%
20.0%
10.0%
0.0%
Reading and Writing
Math
Science
Social Studies
Health*
Specials
Lunch/Recess
Transitions/Other


Weekly Hours - BSD versus National Averages
BSD Weekly Hours
National Weekly Hours
Average Weekly Hours
12
10
8
6
4
2
0
Reading and Writing
Math
Science
Social Studies
Health*
Specials
Lunch/Recess
Transitions/Other

State of Scheduling and Instructional Minutes

- There is a significant amount of variation between schools in how much time is dedicated to different instructional blocks, and the amount of teachers' time spent on collaborative planning, administrative meetings, personal prep time, and assigned school duties varied significantly by school (Choi & Nicholson, 2018).
    - *What is the state of BSD's elementary scheduling expectations and considerations?*

State of Science

- Nationally, elementary science instruction in 2008 was at the lowest number of hours per week as an average since trend data on the measure began in 1988 (Blank, 2013)
- NSTA recommends that science be given equal priority as other core subjects, recommending that schools should strive for at least 60 minutes of science instruction a day (NSTA, 2020).
    - Instructional time for science in the elementary grades has dropped to an average of 2.3 hours per week, and states' averages vary widely in class time spent on science, with average hours per week ranging from 1.9 hours per week in Oregon (which is cited amongst the lowest in the nation, and this cited time is *still* higher than BSD's current model) to 3.8 hours per week in Kentucky (Blank, 2012)
    - Many elementary educators do not receive an adequate amount of professional learning to gain the confidence needed to teach science (Horizon Research 2013; McClure et al. 2017).
    - *How can we use the BSD Science adoption as a vehicle to address this?*

Importance of Science

- Performance on a first-grade general knowledge exam, which included science content, was more predictive of science achievement through eighth grade than measures of achievement in other subjects or student background characteristics (Morgan, Farkas, Hillemeier, & Maczuga, 2016)
    - *How can we design our elementary science program and instructional time to close the gaps we see in secondary science, in terms of both access to rigorous science coursework in HS, and science achievement?*
- A strong STEM identity is a significant predictor of future STEM academic success (Saxton, et al, 2014).
    - How can we design our science and instructional program to nurture student academic identity and motivational resilience in STEM?
- Research on human development has outlined the importance of middle childhood and early adolescence science instruction (i.e., the years between age 6 and 14; Eccles, 1999). Teaching science through playful experiences is an important approach to promote kindergarten students' developing understanding of science concepts (Bulunuz, 2013)

    - Additionally, science equity does not exist as early as third grade. Science education should begin earlier and address the inequities in science teaching, learning, and assessment related to gender, ethnicity, and poverty (Lin & Chu, 2010).
        - *If equity gaps emerge in Science as early as third grade, how can our K-2 approaches be crafted to eliminate inequity and promote play-based inquiry?*

An Integrated Approach and Mindset: *Could BSD follow a more formally supported integration approach? What could it look like?*

- Many states are planning curriculum under the literacy standards of the Common Core that can **lead to integrated approaches to instruction** across language arts, mathematics, science, social studies, and technology (Blank, 2013)
- **Integrated approaches led to greater student achievement in science and language arts across elementary grade level**s, and at all grade levels, teachers linked a variety of strategies including read-alouds, independent reading, at home reading, and writing in various genres that connected hands-on science activities to language arts skills. (Bradbury, 2017)
- Students in an experimental group who received in-depth science instruction that replaced a district-adopted basal reading program with science-content reading designed to facilitate applied comprehension skills **showed significantly greater standardized test achievement as measured by the Iowa Tests of Basic Skills Reading Subtest and the Metropolitan Achievement Test science subtest,** but also displayed a more positive attitude toward science and reading and greater self-confidence in learning science (Romance & Vitale, 1992).
- In an experimental study with 4th graders, students who received an integrated science and literacy approach showed **significantly greater gains on measures of science understanding, science vocabulary, and science writing** (Cervetti, Barber, Dorph, Pearson & Goldschmidt, 2012).
- Re: Social Studies (which is on the horizon for adoption): Teachers who used discipline-specific methods, integrated within English Language Arts, and who reported being satisfied with teaching social studies spent significantly increased time on social studies (Fitchett, Heafner & VanFossen, 2014).

Considerations: Standards vs. Instructional Minutes. *What are the implications of this consideration on the state of SBLS in BSD?*

- With the wave of new standards being adopted by states in mathematics, ELA, and science, and assuming the current length of the school day continues, the key question for reporting from teachers may be what content gets taught relevant to the standards across each subject, rather than how much time is spent on each subject (Blank, 2013)

Elementary Science Pilot Data Summary

Spring 2019 Pilot Data - Carolina, Amplify & STEMScopes

Pilot Teachers - Would you recommend we adopt this curriculum?

Amplify:

Yes	3	38%
No	4	50%
Maybe	1	13%

Carolina Biological

Yes	6	50%
No	6	50%
Maybe	0	0%

STEMScopes

Yes	1	9%
No	9	82%
Maybe	1	9%

Based on the above teacher input, student assessment data, and student interviews. The Project Team voted to move forward with further testing of the Carolina Biological curriculum. Additionally, between spring 2019 and fall 2019, the science leadership team learned of a new curriculum that was not yet published at the beginning of the review process, Twig Science. After the Teacher Cadre and Project Team reviewed Twig, they found it to be high quality and recommended it for side by side piloting with Carolina Biological, the remaining publisher from the spring 2018 pilots.

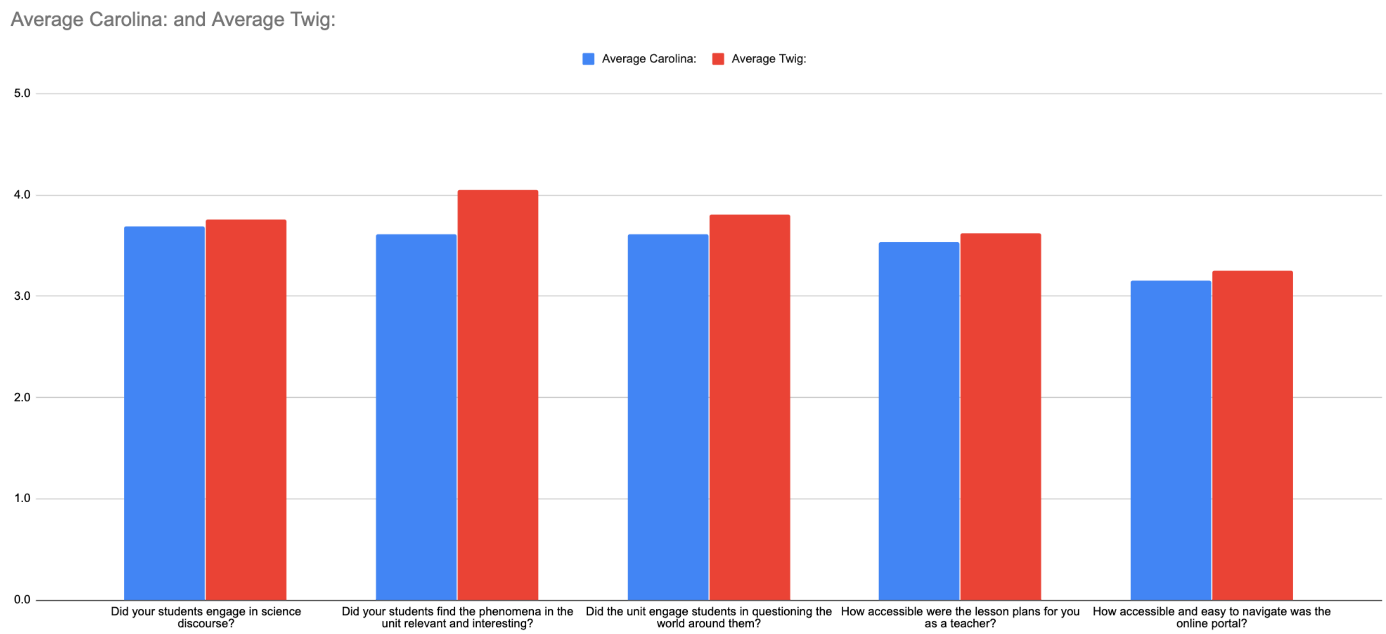
Fall 2019 Pilot Data - Carolina and Twig

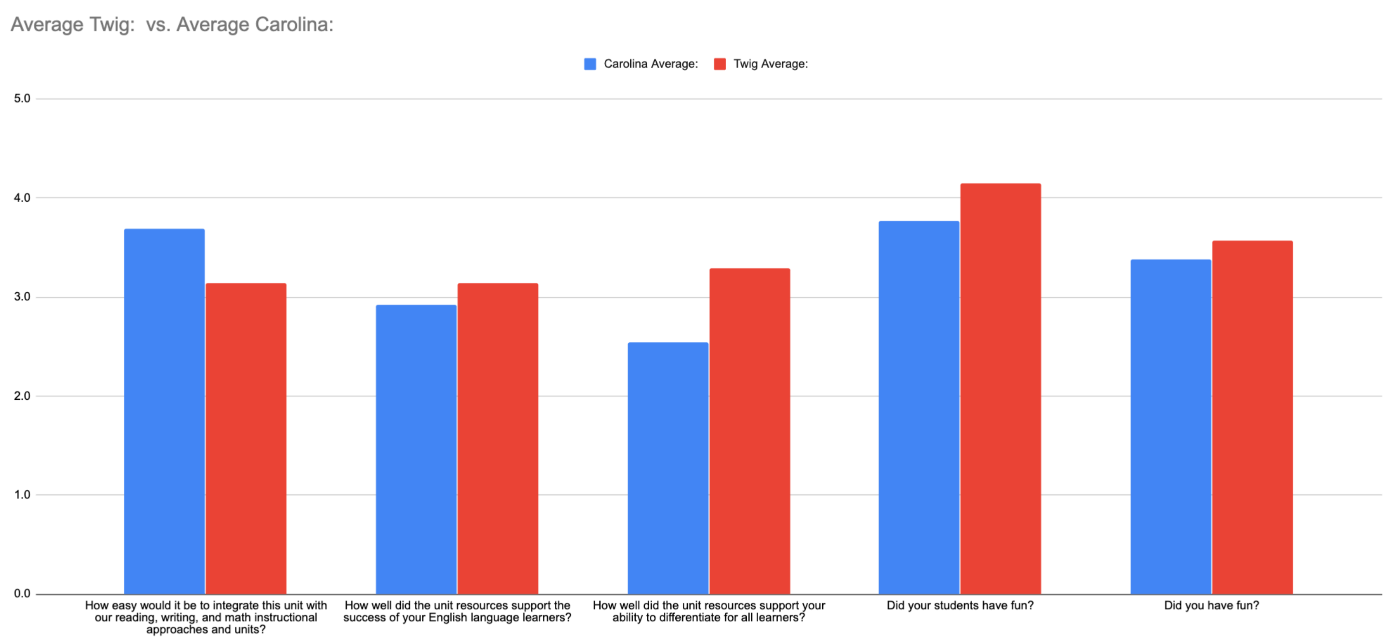
The following was written by the Project Team, summarizing all post pilot data (teacher and student) from the Fall 2019 pilots:

	Carolina	**Twig**
Positives	● Lots of hands on investigations, that the students seemed to enjoy ● Appears that teachers found the planning for the pilot reasonable (not too difficult) (n=7 out of 9)	● Readers/note taking materials are age appropriate and very good (n=1) ● High engagement with real world phenomenon ● Twig is under the Heinemann umbrella, so there may be synergies to be gained due to our ELA curriculum having the same publisher and approaches. ● ELL supports are high quality and are aligned to our ELD adoption.
Negatives	● Carrying out an investigation ● Seems like none of the teachers used any of the readers materials or the readers were not helpful. (n=4) ● Few mathematics and computational thinking opportunities ● Lack of support for ELL students ● Felt like needed to support the lesson with additional materials (visuals, videos, other activities) ● Time estimates provided by Carolina are not accurate. ● Few hands-on materials for earth science unit. ● Students did not like the “packets” ● The student worksheets were not engaging and often not phenomena-based. ● Student readers were not used by teachers.	● Taking a lot of time (more than teachers have) ● Teacher reported having to buy items that were needed but not included in the kits/not things she had in her classroom. (note: this was only for food items, which publishers are not allowed to ship - district will need to provide these items) ● Few hands on investigations for earth science unit. (n=1) ● Lots of reading, not enough hands on opportunities ● Leveled readers in English only - for Spanish, only 1 option.
Twig/Carolina Comparison	● I taught the 4th grade Carolina unit and Twig in first grade. Twig had many more language supports for students with limited English proficiency. My students enjoyed working in their TWIG notebooks but many of my fourth graders didn’t like	

Summary Statements	the Carolina worksheets. ● Observational data is stronger for Twig ● Student responses are similar for both programs ● Both appear to integrate the SEP's appropriately. ● Incorporation of SEPs is evident in both, but Twig surpassed Carolina in Planning and Carrying out Investigations, Math & Computational Thinking, and Obtaining, Evaluating and Communicating Info (~0.5 or more point difference in each case on 2 point scale) ● My team and I taught the 5th grade Twig unit on Earth science. It was overall well received by all of us. We found the lessons engaging, the videos well done, the Twig book very user friendly for the kids and the hands-on that we did helped them to see a link between the phenomenon and all of unit tasks. The few things that we found that were not user friendly were changed or will be changed in the next iteration of the Twig Book. The staff was super helpful and made sure we had what we needed. ● Twig has a more STEM focus that allows for students to uncover the phenomenon through either investigations, research, and simulations versus "verifying" what they were told the concepts were in the initial video in Carolina. The written work that is done by students in TWIG incorporates more of the "writing, thinking and communicating of scientists" than Carolina. The format is more engaging in TWIG and is not so redundant and repetitive as Carolina. ● Twig surpasses Carolina in all of the numerical measures except for one. ● Twig materials don't need to be changed, they are interactive and engaging as is ● Carolina is very worksheet heavy ● Many Carolina lessons don't align with NGSS ● Based on conversations with pilot teachers at Project Team meetings, it seems that the professionals at Twig were very responsive to teacher questions and concerns. I see this as a distinct advantage. ● The data appear to support the adoption of Twig. Additionally, the data appear to show that the lessons and media are engaging. ● Observational data seems to support Twig ● Twig's connection to reading and writing is solid. ● Multi-media supports Twig. ● Twig appears to have a more embedded set of ELD supports which will allow the content to be more accessible.

Post Pilot Teacher Feedback





How accessible and helpful were the student readers?

<u>Twig</u>

Most teachers did not use the readers due to a lack of time. Those who did try them out commented that the reading level was too high so they read them as a group.

<u>Carolina</u>

Most teachers did not use the readers due to a lack of time.

Tell us about the hands-on investigations. Were there enough of them? Did they engage students in all three NGSS dimensions (science and engineering practices, crosscutting concepts, and core ideas)? Did they work effectively in the classroom?

<u>Twig</u>

Teachers commented that hands on takes a lot of time. Some units had enough hands on, one did not.

<u>Carolina</u>

Some units had enough hands on, others did not.

Would you recommend this curriculum to the Project Team for adoption by the district? Why or why not?

<u>Twig</u>

Yes - 13 (65%)
No - 5 (25%)
Maybe - 2 (10%)

"I would recommend this curriculum. It is inquiry based, it responds to the learning targets. Very engaging for the students. Having the spanish components, including the teacher manuals is a fantastic resource for our Dual Language programs."

"No, teachers do not have enough time to support this curriculum. We also do not have enough time dedicated to science to work with this curriculum."

<u>Carolina</u>

Yes - 5 (38%)

No - 5 (38%)
Maybe - 3 (23 %)

“Yes, I think a lot of the activities were worthwhile. With more practice and fine-tuning I think this would be a good curriculum.”

“I would not recommend that this is adopted by the district. There are many lessons that do not align to our standards. The lessons take FAR longer than they say they are going to. It is a very worksheet heavy curriculum (or you can do it digitally, but honestly, that's still a worksheet...it's just on the computer) where students are answering comprehension questions. The curriculum had very few visuals and did not support our ELLs. We did a lot of front loading with vocabulary when those words weren't yet relevant to students...and they engaged in investigations after the phenomena was fed to them in some instances.”

Was the time spent planning for and teaching the pilot realistic for teachers in the district?

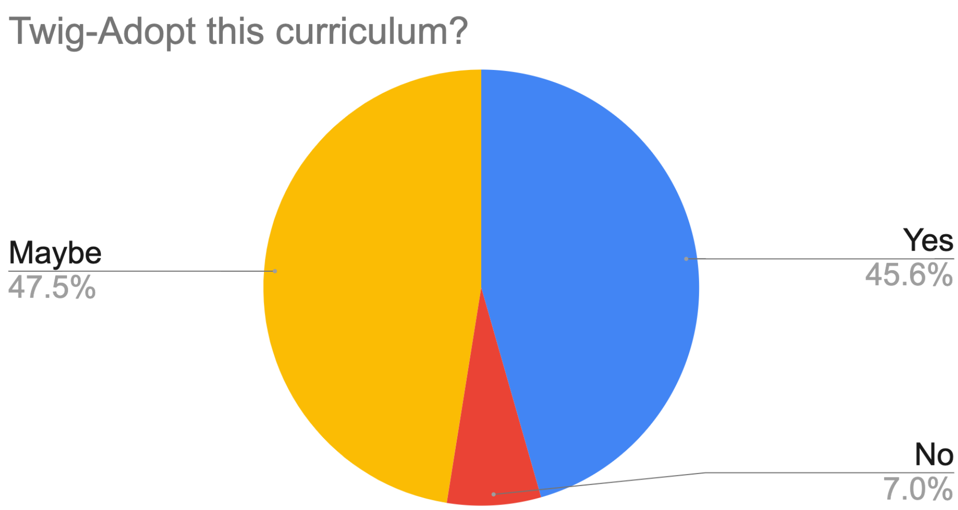
Twig
10% - Yes, Very doable
25% - Yes, but it will be a challenge
40% - Maybe- it would be difficult for most teachers but they could likely get through most of it
25% - No - teachers will find this so difficult as to be prohibitive of them teaching the unit

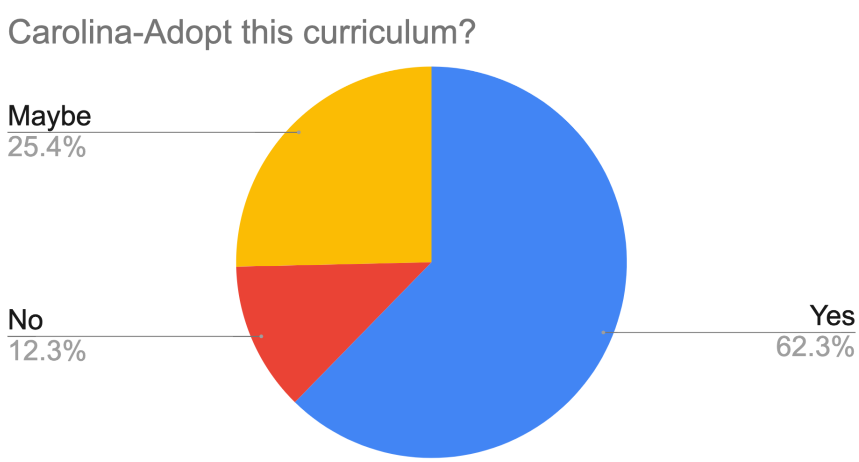
Carolina
23% - Yes, Very doable
46% - Yes, but it will be a challenge
31% - Maybe- it would be difficult for most teachers but they could likely get through most of it

Post Pilot Student Feedback (1-5 Scale)

Which Science curriculum did your teacher use? (your teacher can tell you this)	Did these science lessons give you opportunities to discuss your ideas with your classmates?	How easy was it to understand the directions?	How easy was it to navigate or use the online site (if you used it)?	Did these science lessons give you opportunities to do hands on activities?	Did the science lessons make it easy for you to understand the science ideas and improve the skills you were learning?	Did you feel you were challenged?
Carolina Average	3.89	3.74	3.26	3.66	3.71	3.69
Carolina SD	0.97	0.96	1.42	1.07	1.10	1.23

Twig Average	3.85	3.78	3.20	3.83	3.70	3.96
Twig SD	0.99	0.97	1.24	1.08	0.99	1.05





Excerpts from Student Surveys

Twig

I liked the hands on activities.

We did not have a lot of time to work on or build our car.

Carolina

The packets were very confusing and boring.

I liked the hands on stuff because it helps me learn better.

Post Lesson Student Interviews

What did you learn in the science lesson today?

Twig
-go outside and find objects and figure out what they are made from
-historic earthquakes that were smaller magnitude, but bigger deaths, and bigger magnitude but less deaths, that is probably due to better structures, more support on the bridges and stadiums and buildings, wire or more support on the bottom.

Carolina
-We learned about different plants and animals, how they are the same and different.
-how weather and climate are different

Tell me something you have liked about your science lessons in the last few weeks?

Twig
-Feliz, porque todo el tiempo en las ciencias leemos los libros de las ciencias y hacemos experimentos. (Happy because we read and do experiments all the time in science)
-Online-made custom earthquakes where students can make different magnitudes, random-ended up in oceans, also picked date, write it down on paper, building tower with paper.

Carolina
-Seeing the butterflies grow.
-I like the labs. I like the plants and growing the butterflies. I love science right now, I wish we did it more.

Middle School Science Pilot Data Summary Spring/Fall 2019

Spring 2019 Pilot:

Curriculum	Patterns/Trends	Questions	Conclusions	Recommendations
Amplify	High rate of "no's" from teachers. PD seemed to be of high quality (but not local).	Cost of kits: consumable vs. non-consumable? Are lessons aligned to HS and Elem targets?	Survey shows lack of teacher support.	No teacher support = no go
IQWST	Strong positives about student discussions. Evidence of higher student engagement. Higher level of consistency of quality and better alignment.	Cost of kits: consumable vs. non-consumable? Are lessons aligned to HS and Elem targets? Would student survey results been different if the sample size was higher? Spanish materials: how good are they? Is the scope well-aligned to what teachers need? What PD is available?	High ratings from students. Assessment and growth scores were highest. Best alignment with Patterns curriculum.	Stong front-runner, "yes"
STEMScopes	Lessons based off of whole class approaches. Student quotes indicate perhaps too easy. Tend to be more positives from newer teachers.	Cost of kits: consumable vs. non-consumable? Are lessons aligned to HS and Elem targets?	Evidence points to a possible lack of rigor. Easy to use, but almost too easy perhaps? Lowest student outcomes (on pre/post).	Need to explore rigor. Leaning "no".

Would you recommend we adopt this curriculum? (Teacher Responses)

Amplify

Yes	2	25%
No	6	75%
Maybe	0	0%

IQWST

Yes	4	57%
No	1	14%
Maybe	2	29%

STEMScopes

Yes	3	50%
No	2	33%
Maybe	1	17%

Fall 2019 Pilot:

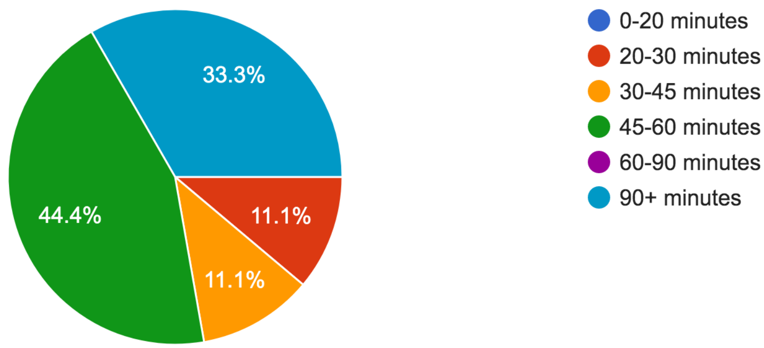
Summary of IQWST data by project team:

	IQWST
Positives	• A majority of students feel successful with IQWST • Students enjoy the experiments and hands-on aspect. • Teachers indicate there is strong support for differentiation • Observational data is strong. All of the practices were engaged with and all students interviewed had positive responses/experiences to share. • Students like the amount of hands on. • Student feedback indicates that there is a lot of hands-on, more than they had done in previous years
Negatives	• Teachers were concerned that it was difficult to modify or reformat the worksheets for students, but the vendor has let us know that they will provide editable files if we adopt (the pilot teachers only had PDFs). • This will be a shift in practice for some teachers, to more hands on. This might be challenging for teachers and we will need to support them with PD on how to do the labs.

Post Pilot Teacher Feedback

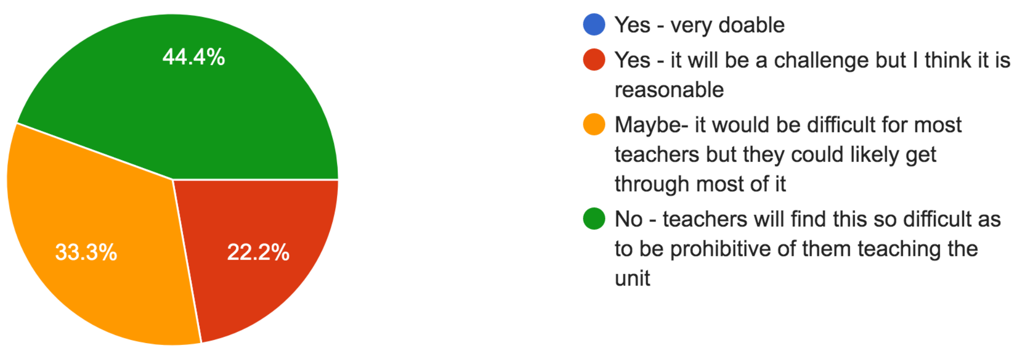
How much time did you need to devote to the planning of science per day of instruction with the pilot?

9 responses



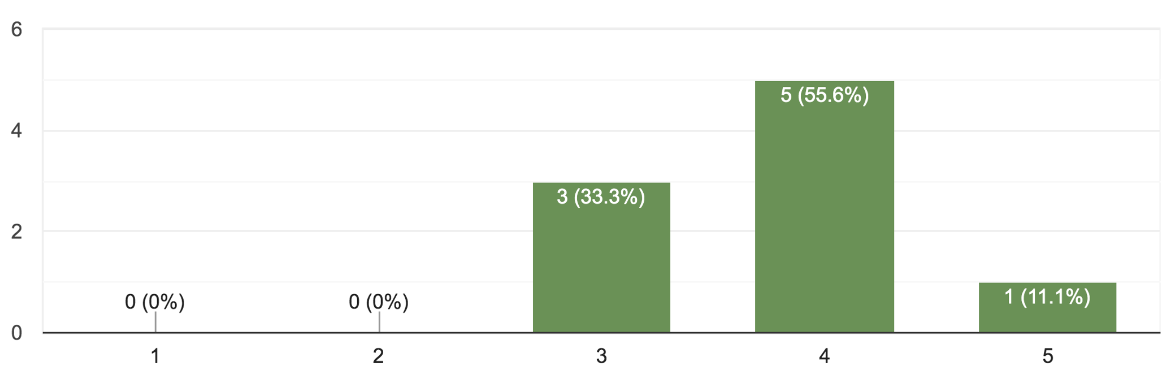
Was the time spent planning for and teaching the pilot realistic for teachers in the district?

9 responses

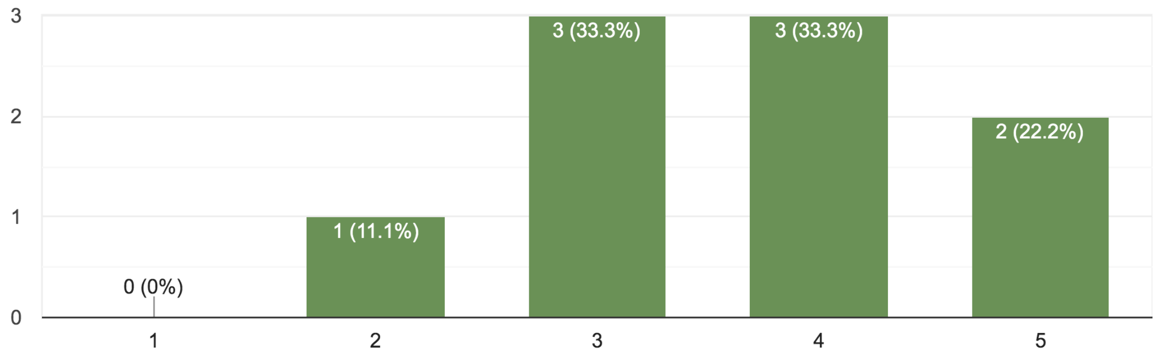


Did the unit engage students in questioning the world around them?

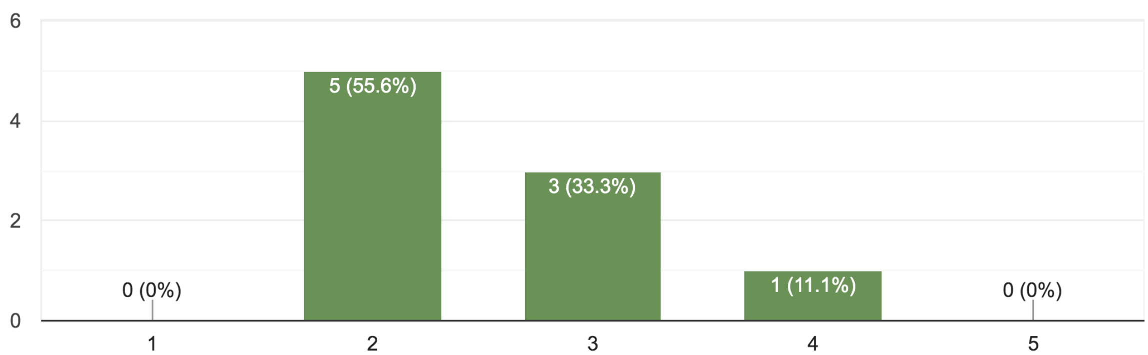
9 responses



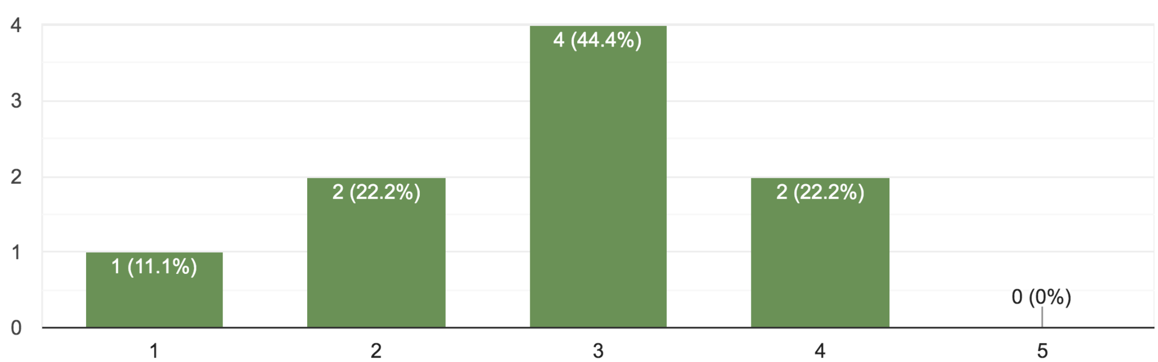
Did your students engage in science discourse?
9 responses



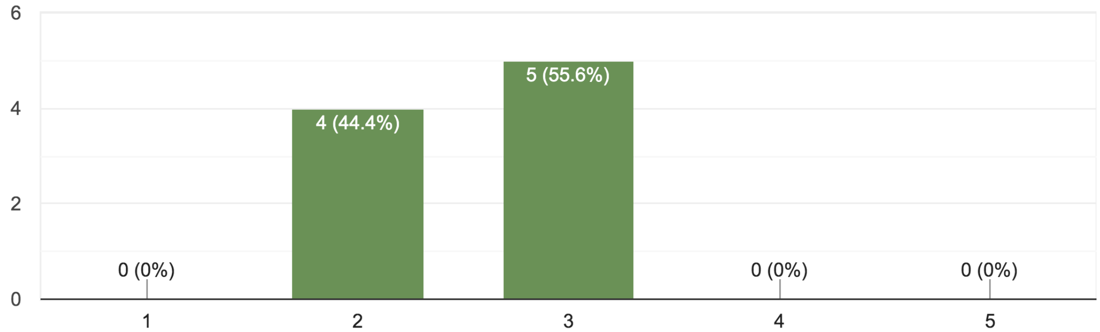
How accessible were the unit instructions for you as a teacher?
9 responses



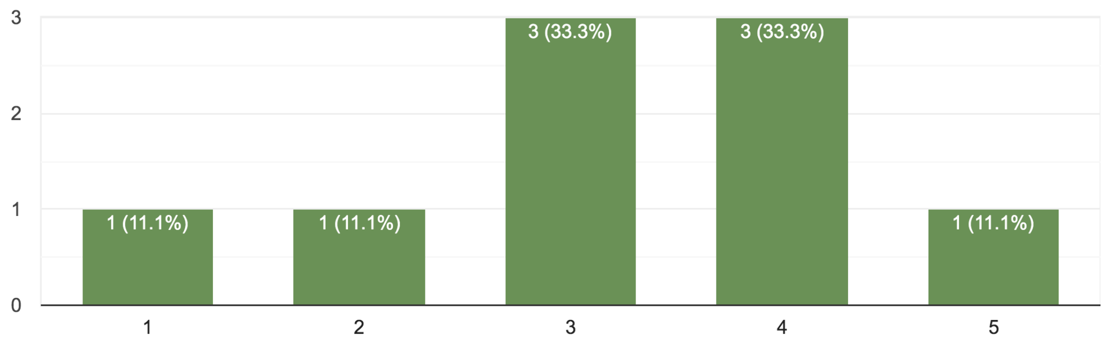
How well did the unit resources support the success of your English language learners?
9 responses



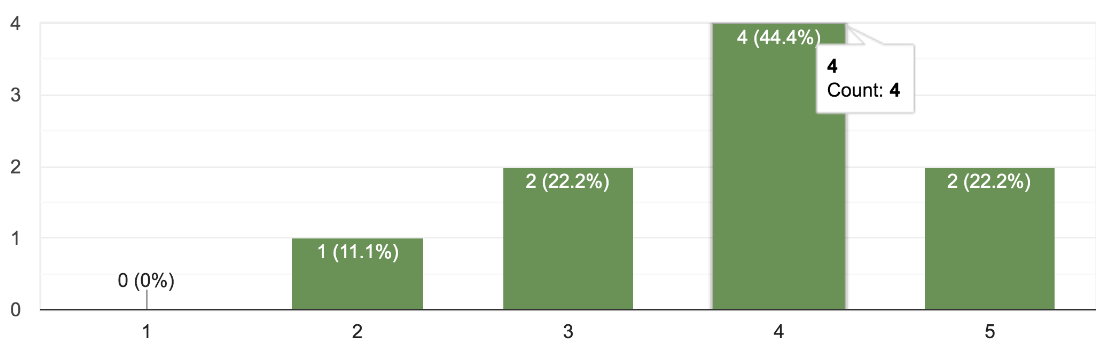
How well did this curriculum support students in reading engaging, accessible non-fiction text?
9 responses



How well did the unit resources support your ability to differentiate for all learners?
9 responses

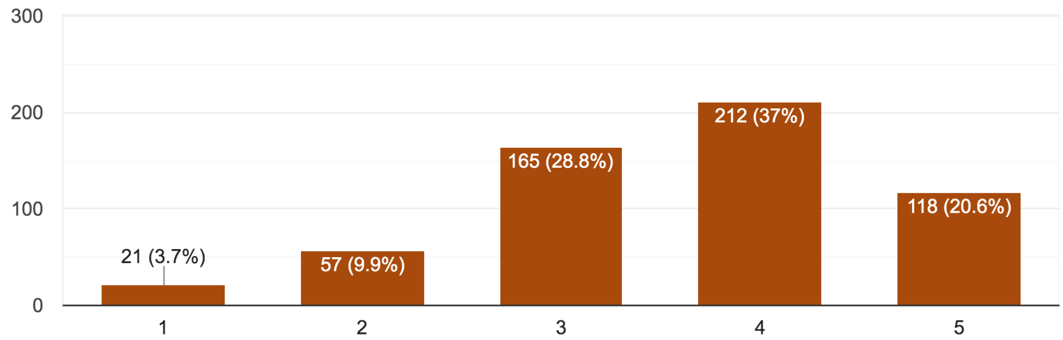


Did your students have fun?
9 responses

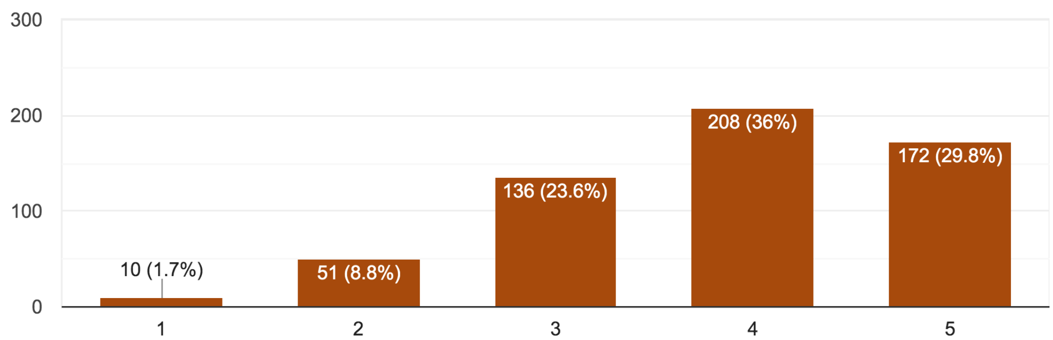


Post Pilot Student Feedback

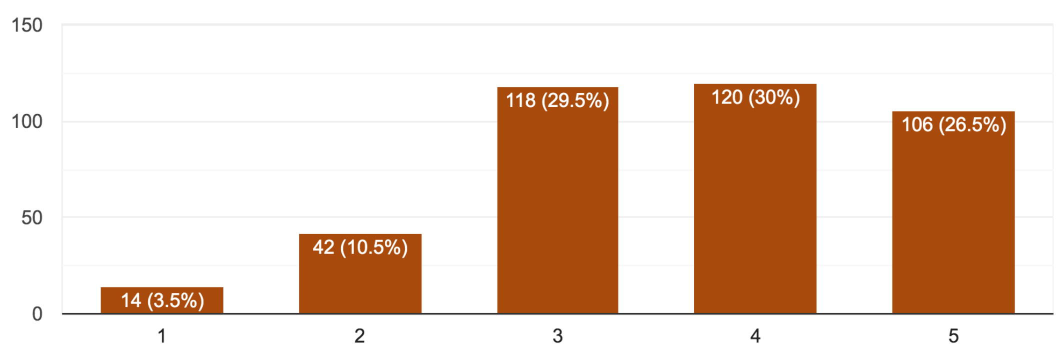
Did the curriculum allow you to share ideas with your classmates through discussion?
573 responses



How easy was it to understand the lab and activity directions?
577 responses

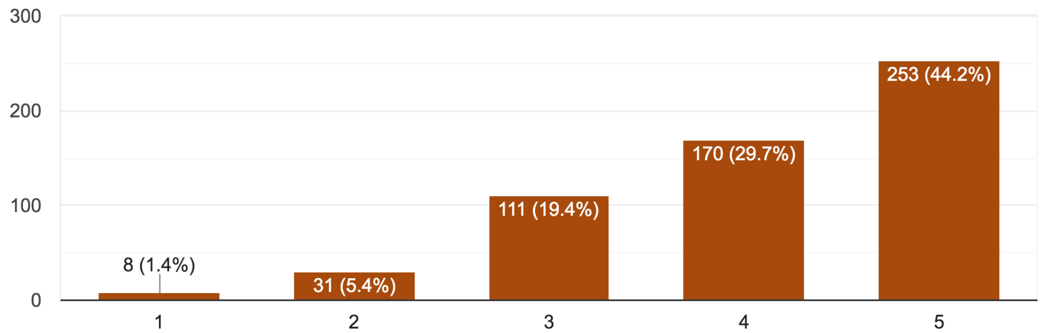


How easy was it to navigate or use the curriculum (if you used the online site)?
400 responses



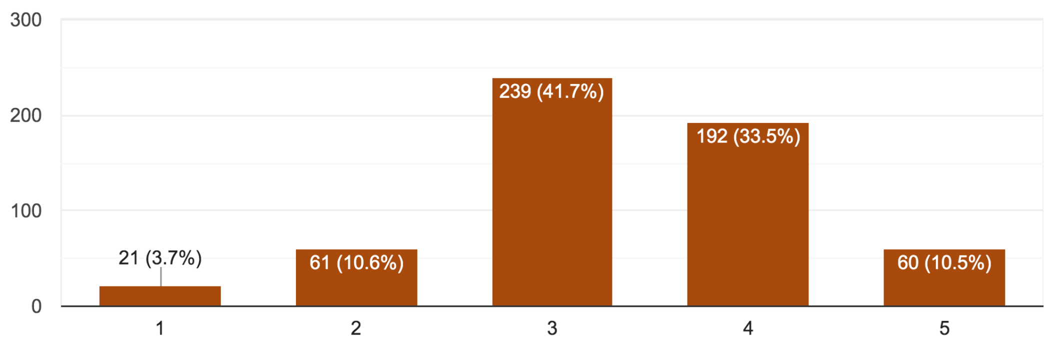
Did these science lessons give you opportunities to do hands on activities?

573 responses



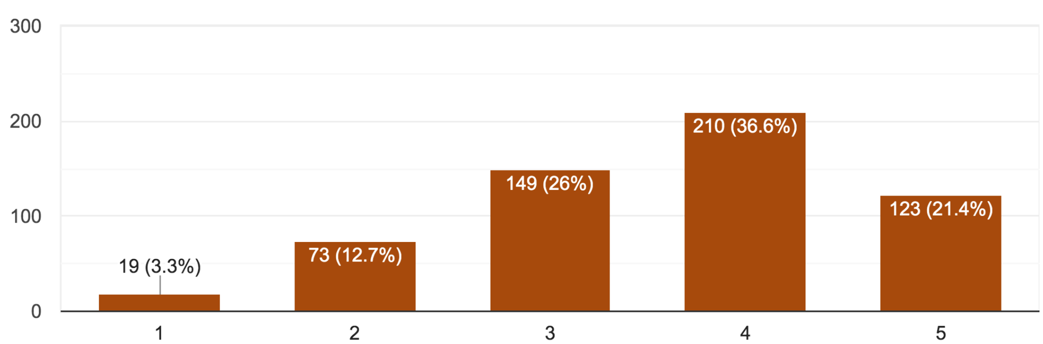
Did the lessons and activities make it easy for you to understand the science ideas and improve the skills you were learning? (3 = I was about as confident as I usually am)

573 responses

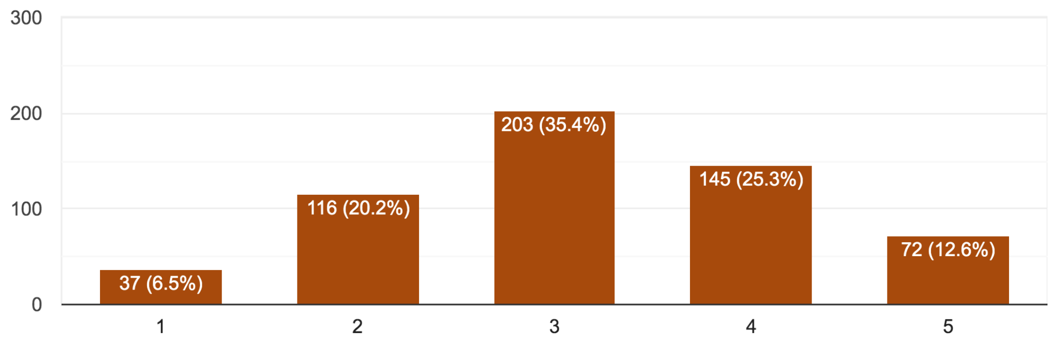


Did you feel you were appropriately challenged?

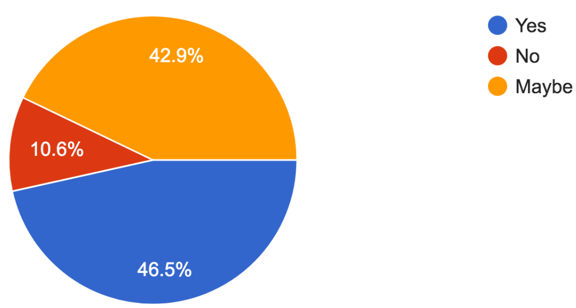
574 responses



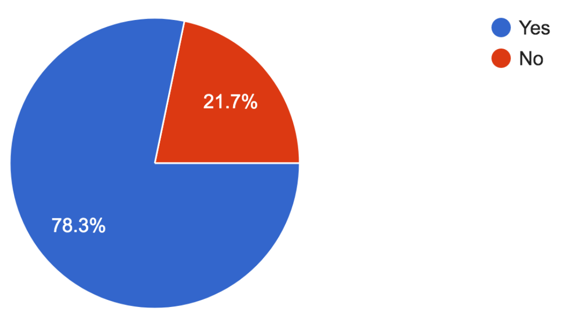
Did you have opportunities to self assess and provide feedback to your peers?
573 responses



Would you like to have more science lessons like these?
576 responses



Would you recommend Beaverton adopt and use this curriculum?
571 responses



Tell me something you have liked about your science lessons in the last few days/weeks?

-Obviously the labs, we are doing way more labs than we usually do. Last year we didn't do labs very often, and now we do them basically every day. I also like the group work, because I can get other people's opinions. I also really like typing my labs in the online notebook. Usually I can focus better when I have it online.

-The experiments, there are a lot more experiments than we've had before. They are fun, it's not just notes. (when asked about readings) I do find them helpful, some of the readings have some information I don't need, but it's fine, and in general they are good.

-I like that it is more about us figuring it out, she doesn't tell us the answer, we have to use evidence to figure it out. Like with the convection box, and the water bottle, she didn't have to tell us, we figured it out and I like that.

How have you felt during science time in the last few days/weeks? Do you feel more, about the same, or less successful than usual?

-I feel more successful, I feel like I'm doing good in science. I'm doing way better in science than my other classes, and better in science now than last year.

-I feel more successful than normal. Last year I didn't feel successful in science because we didn't do much partner grouping. In this class I'm doing better because I get to practice saying my ideas in a small group and I feel more confident. Nothing has been a problem, I like this unit so far. Right now I really like science, but up until this class I've never really liked science. I like this unit even better than when we started, I like my teacher, but this unit is even better. I'm more skilled with my hands, so I feel like I'm successful with this unit.

-I feel about the same, but it is more fun than usual.

Is there anything you haven't liked or found too difficult?

-Learning how to use Chromebooks was hard at first, because that was new for us, but it is good now because we learned. The lessons are informative and it is easy to take what we know and explain it. Nothing I don't like.

-I don't like the writing part because it's difficult. I have to explain what happened and what I saw.

-Some of the questions are hard or confusing, but not always. I feel like I do get it by the end.