Essential Middle School Lab Manual: NGSS Correlations

Below is a list of the 16 activities in the Essential Middle School lab manual. The primary Next Generation Science Standards (NGSS*) Performance Expectation supported by each activity is shown in the column on the right.

Lab #	Activity Name and Description	NGSS Performance Expectation[1] (PE) Supported
1	Humidity and Dew Point *Students use a weather sensor to examine the differences between absolute and relative humidity and relate those measurements to dew point.*	MS-ESS2-5: Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.
2	Red Flags and Fire Weather Zones *Students identify the conditions that warrant a Red Flag Warning in their area and then use a weather sensor to create a weather station to monitor those conditions.*	MS-ESS3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
3	Blockly Extension: Red Flag Warning *Students use weather data to create a program in Blockly that will alert the user to an active Red Flag Warning.*	MS-ESS3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
4	Family Preparedness Plan: Evacuation Map *Students will use a weather sensor with GPS to map out the perimeter of their school site and then identify evacuation routes as well as safe meeting areas.*	MS-ESS3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
5	Acid Rain and Weathering *Students will use a pH sensor to model the effects of acid rain on various materials.*	MS-EES3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
6	Night and Day *Students will use different models to recreate the effects of the Sun on the Earth. In Part 1, student use s simple model to examine night and day. In Part 2, students will use a more accurate model to examine, predict, and describe seasons based on light intensity data.*	MS-ESS1-1: Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.
7	Seasons and Temperature *Students create a model of the Sun and Earth and use a temperature sensor to examine, predict, and describe temperature differences between seasons.*	MS-ESS1-1: Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.
8	Photosynthesis *Using a carbon dioxide sensor, student measure the change in carbon dioxide (in a closed system) to facilitate an understanding of the relationship between carbon dioxide, respiration, and photosynthesis of plants.*	MS-LS1-6: Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. MS-LS1-7: Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.

Lab #	Activity Name and Description	NGSS Performance Expectation[1] (PE) Supported
9	Introduction to Acids and Bases *Students use a pH sensor to determine the pH of common household chemicals.*	MS-PS1-2: Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
10	Blockly Extension: pH *Students use a pH sensor and Blockly coding software to create a program that identifies acidic and basic solutions. Additionally, students are introduced and then asked to refer to the steps of the Computational Thinking Process as it relates to the tasks they are completing.*	MS-PS1-2: Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
11	Chemical Reactions & Energy Transfer *Students use sodium bicarbonate, vinegar, and a temperature sensor to investigate energy transfer in a chemical reaction.*	MS-PS1-2: Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
12	Blockly Extension: Chemical Reactions & Energy Transfer *Students are challenged to create a Blockly coding program that alerts the user to a chemical change.*	MS-PS1-6: Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.
13	Thermoregulation *Using a temperature sensor, students will explore the relationship between internal body temperature and the skin surface temperature of their hand under different conditions.*	MS-LS1-3: Use argument supported by evidence for how the body is s system of interacting subsystems composed of groups of cells.
14	Describing Motion *Students will investigate how position, velocity, and acceleration can be described and quantified using a motion sensor.*	MS-PS2-2: Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
15	Forces and Interactions *Students will investigate the relationship between force and acceleration. Newton's first law and second law will also be explored.*	MS-PS2-2: Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
16	Waves and Energy *Students learn that sound is produced by vibrating objects, that sound travels from a source through air, solids, and liquids, and its loudness depend on the amplitude of the wave. The amplitude of the waves dines the waves energy. The frequency of the wave defines the pitch.*	MS-PS4-2: Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

* NGSS is a registered trademark of Achieve. Neither Achieve nor the lead states and partners that developed the Next Generation Science Standards were involved in the production of this product, and do not endorse it.

[1] Performance expectations taken verbatim from NGSS Lead States. 2013. Next Generation Science Standards: For States, By States. Washington, DC: The National Academies Press

PASCO's technology and laboratory investigations move students from the low-level task of memorizing science facts to developing higher-level data analysis skills, constructing concepts, and applying science concepts to explain everyday events. Science can be learned at a deep level when abstract science concepts are connected to "real-world" science investigations. Hands-on, technology-based laboratory experiences help bridge the gap between theory and observation, driving students toward a greater understanding of natural phenomena. Students also practice important science and engineering skills that include: *asking questions and defining problems, planning and carrying out investigations, analyzing and interpreting data, developing and using models, constructing explanations and designing solutions, engaging in argument from evidence, using mathematics and computational thinking,* and *obtaining, evaluating, and communicating information*[1].

While recognizing that each location may have specific standards to address, these materials use the NGSS as a foundation Three components comprise the NGSS: Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts. All lab activities in PASCO's science investigation manuals are compatible with the three dimensions of the NGSS:

- The *Science and Engineering Practices* help students to develop a systematic approach to problem solving that builds in complexity from kindergarten to their final year in high school. The practices integrate organization, mathematics and interpretive skills so that students can make data-based arguments and decisions.
- *Disciplinary Core Ideas* are for the physical sciences, life sciences, and earth and space sciences. The standards are focused on a limited set of core ideas to allow for deep exploration of important concepts. The core ideas are an organizing structure to support acquiring new knowledge over time and to help students build capacity to develop a more flexible and coherent understanding of science.
- *Crosscutting Concepts* are the themes that connect all of the sciences, mathematics and engineering. As students advance through school, rather than experiencing science as discrete, disconnected topics, they are challenged to identify and practice concepts that cut across disciplines, such as "cause and effect". Practice with these concepts that have broad application helps enrich students' understanding of discipline-specific concepts.

PASCO's lab activities are designed to guide students through initial investigations that help them learn scientific processes while they explore a core science topic. Students are then able to design and conduct extended inquiry investigations. The use of electronic sensors reduces the time for data collection, and increases the accuracy of results, providing more time in the classroom for independent investigations.

In addition to supporting the scientific inquiry process, the lab activities fulfill STEM education requirements by bringing together science, technology, engineering, and math. An integration of these areas promotes student understanding of each of these fields and develops their abilities to become self-reliant researchers and innovators. When faced with an idea or problem, students learn to develop, analyze, and evaluate possible solutions. This prepares students for collaboration with others to construct and test a procedure or product. PASCO's SPARKvue software now includes Blockly, which is a block-based coding program. Students use real-time data within the coding programs they are challenged to create.

Information and computer tools are essential to modern lab activities and meeting the challenge of rigorous science standards, such as NGSS. The use of sensors, data analysis and graphing tools, models and simulations, and work with instruments, all support the science and engineering practices as implemented in a STEM-focused curriculum, and are explicitly cited in NGSS. PASCO's lab activities provide students with hands-on and minds-on learning experiences, making it possible for them to master the scientific process and the tools to conduct extended scientific investigations.

[1] NGSS Lead States. 2013. *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press

About the PASCO Essential Science Lab Manuals

This manual presents teacher-developed laboratory activities using current technologies to help you and your students explore topics, develop scientific inquiry skills, and prepare for state level standardized exams. Using electronic-sensor data collection, display and analysis devices in your classroom fulfills STEM requirements and provides several benefits. Sensor data collection allows students to:

- observe phenomena that occur too quickly or are too small, occur over too long a time span, or are beyond the range of observation by unaided human senses
- perform measurements with equipment that can be used repeatedly over the years
- collect accurate data with time and/or location stamps
- rapidly collect, graphically display, and analyze data so classroom time is used effectively
- practice using equipment and interpreting data produced by equipment that is similar to what they might use in their college courses and adult careers