PhD Science® K–5 Curriculum Correlation to Pennsylvania Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic (STEELS) Standards

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PhD Science® K–2 Curriculum Correlation to Pennsylvania Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic (STEELS) Standards: Level K

The *PhD Science* Level K curriculum fully aligns with the Kindergarten science and engineering standards in the Pennsylvania STEELS standards. *PhD Science*, which aligns with the Next Generation Science Standards, does not explicitly cover technology topics.

Kindergarten Standards

3.1.K.A Life Science—From Molecules to Organisms: Structures and Processes

Performance Expectation	Aligned *PhD Science* Lessons*
Use observations to describe patterns of what plants and animals (including humans) need to survive.	Level K M3 L4–16, 19–22, 27–29

3.2.K.A Grade—Motion and Stability: Forces and Interactions

Performance Expectation	Aligned *PhD Science* Lessons
Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.	Level K M2 L17–23

3.2.K.B Physical Science—Motion and Stability: Forces and Interactions

Performance Expectation	Aligned *PhD Science* Lessons
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.	Level K M2 L1–23

3.2.K.C Physical Science—Energy

Performance Expectation	Aligned *PhD Science* Lessons
Make observations to determine the effect of sunlight on Earth's surface.	Level K M1 L8–11, 28–30

* **Key:** Module (M), Lesson (L), More to the Story lesson (MttS)

3.2.K.D Physical Science—Energy

Performance Expectation	Aligned *PhD Science* Lessons
Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.	Level K M1 L12–16, 28–30

3.3.K.A Earth and Space Science—Earth's Systems

Performance Expectation	Aligned *PhD Science* Lessons
Use and share observations of local weather conditions to describe patterns over time.	Level K M1 L1–11, 17–24, 28–30 Level K M4 L25
Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.	Level K M4 L1–10, 14–16, 26–28

3.3.K.C Earth and Space Science—Earth and Human Activity

Performance Expectation	Aligned *PhD Science* Lessons
Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.	Level K M3 L1–3, 9–29 Level K M4 L1–2, 8–9, 11–13

3.3.K.D Earth and Space Science—Earth and Human Activity

Performance Expectation	Aligned *PhD Science* Lessons
Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.	Level K M1 L22–30

3.3.K.E Earth and Space Science—Earth and Human Activity

Performance Expectation	Aligned *PhD Science* Lessons
Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.	Level K M4 L14–24, 26–28

Science and Engineering Practices

Asking Questions and Defining Problems	Aligned *PhD Science* Lessons
Ask questions based on observations to find more information about the natural and/or designed world(s).	Level K M1 L1–3, 22–26 Level K M2 L1–3, 9 Level K M3 L1–3, 14–16, 27–29
Define a simple problem that can be solved through the development of a new or improved object or tool.	Level K M1 L4–7, 12–16

Developing and Using Models	Aligned *PhD Science* Lessons
Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).	Level K M3 L1–3, 9–12, 19–20 Level K M4 L1–9, 11–16

Planning and Carrying Out Investigations	Aligned *PhD Science* Lessons
With guidance, plan and conduct an investigation in collaboration with peers.	Level K M2 L7–8, 10–15 Level K M3 L4–8
Make observations (firsthand or from media) to collect data that can be used to make comparisons.	Level K M1 L4–7, 10–11, 17–24, 27–30 Level K M2 L7–8, 16–23 Level K M3 L21

Analyzing and Interpreting Data	Aligned *PhD Science* Lessons
Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions.	Level K M3 L4–8, 14–20, 22–26 Level K M4 L25
Analyze data from tests of an object or tool to determine if it works as intended.	Level K M4 L20–24

Constructing Explanations and Designing Solutions	Aligned *PhD Science* Lessons
Use tools and/or materials provided to design and/or build a device that solves a specific problem or a solution to a specific problem.	Level K M2 L17–20
Generate and/or compare multiple solutions to a problem.	Level 1 M3 L21–25 Level 2 M2 L8–12, 14–17

Engaging in Argument from Evidence	Aligned *PhD Science* Lessons
Construct an argument with evidence to support a claim.	Level K M3 L17–21, 27–29

Obtaining, Evaluating, and Communicating Information	Aligned *PhD Science* Lessons
Read grade-appropriate texts and/or use media to obtain scientific information to describe patterns in the natural world.	Level K M4 L1–2, 6–10, 14–16, 18–19
Compare and/or combine across complex texts and/or other reliable media to support the engagement in other scientific and/or engineering practices.	Level 3 M2 L13–15 Level 5 M2 L6–7, 20 Level 5 M3 L25–27
Communicate information or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.	Level K M1 L12–16, 28–30 Level K M2 L21–23 Level K M3 L27–29 Level K M4 L20–24, 26–28

Disciplinary Core Ideas

Physical Science

Motion and Stability: Forces and Interactions

PS2.A: Forces and Motion	Aligned *PhD Science* Lessons
Pushes and pulls can have different strengths and directions.	Level K M2 L7–23
Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it.	Level K M2 L1–23

PS2.B: Types of Interactions	Aligned *PhD Science* Lessons
When objects touch or collide, they push on one another and can change motion.	Level K M2 L13–23

Energy

PS3.B: Conservation of Energy and Energy Transfer	Aligned *PhD Science* Lessons
Sunlight warms Earth's surface.	Level K M1 L8–16, 28–30

PS3.C: Relationship Between Energy and Forces	Aligned *PhD Science* Lessons
A bigger push or pull makes things speed up or slow down more quickly.	Level K M2 L7–9, 21–23

Life Science

From Molecules to Organisms: Structures and Processes

LS1.C: Organization for Matter and Energy Flow in Organisms	Aligned *PhD Science* Lessons
All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow.	Level K M3 L4–16, 19–20, 22, 27–29

Earth and Space Science

Earth Systems

ESS2.D:Weather and Climate	Aligned *PhD Science* Lessons
Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time.	Level K M1 L1–11, 17–24, 28–30 Level K M4 L25

ESS2.E: Biogeology	Aligned *PhD Science* Lessons
Plants and animals can change their environment.	Level K M4 L1–10, 14–16, 26–28

Earth and Human Activity

ESS3.A: Natural Resources	Aligned *PhD Science* Lessons
Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do.	Level K M3 L1–3, 9–29 Level K M4 L1–5, 8–9, 11–16

ESS3.B: Natural Hazards	Aligned *PhD Science* Lessons
Some kinds of severe weather are more likely than others in a given region. Weather scientists forecast severe weather so that the communities can prepare for and respond to these events.	Level K M1 L17–20, 22–30

ESS3.C: Human Impacts on Earth Systems	Aligned *PhD Science* Lessons
Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things.	Level K M4 L11–24, 26–28

Engineering, Technology, and Applications of Science

ETS1.A: Defining and Delimiting Engineering Problems	Aligned *PhD Science* Lessons
A situation that people want to change or create can be approached as a problem to be solved through engineering. In solving the problem, there may be different parts that need to connect. Such problems may have many acceptable solutions.	Level K M1 L4–7, 12–16 Level K M2 L17–20
Asking questions, making observations, and gathering information are helpful in thinking about problems.	Level K M1 L12–16
Before beginning to design a solution, it is important to clearly understand the problem.	Level K M1 L12–16

ETS1.B: Developing Possible Solutions	Aligned *PhD Science* Lessons
Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	Level K M2 L17–20 Level K M4 L20–24

ETS1.C: Optimizing the Design Solution	Aligned *PhD Science* Lessons
Because there is always more than one possible solution to a problem, it is useful to compare and test designs.	Level K M4 L20–24

Crosscutting Concepts

Patterns	**Aligned *PhD Science* Lessons**
Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.	Level K M1 L17–30 Level K M2 L1–6, 17–20 Level K M3 L4–8, 14–20, 22, 26–29 Level K M4 L3–5

Cause and Effect	**Aligned *PhD Science* Lessons**
Events have causes that generate observable patterns.	Level K M2 L4–16, 21–23 Level K M4 L3–5, 10, 14–19, 26–28
Simple tests can be designed to gather evidence to support or refute student ideas about causes.	Level K M2 L10–12, 17–20

Systems and System Models	**Aligned *PhD Science* Lessons**
Systems in the natural and designed world have parts that work together.	Level K M3 L1–3, 9–13, 19–21, 23–25, 27–29 Level K M4 L1–9, 11–16

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology	**Aligned *PhD Science* Lessons**
People encounter questions about the natural world every day.	Level K M3 L1–3 Level K M4 L25

Influence of Engineering, Technology, and Science on Society and the Natural World	**Aligned *PhD Science* Lessons**
People depend on various technologies in their lives; human life would be very different without technology.	Level K M4 L18–19

PhD Science® K–2 Curriculum Correlation to Pennsylvania Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic (STEELS) Standards: Level 1

The *PhD Science* Level 1 curriculum fully aligns with the Grade 1 science and engineering standards in the Pennsylvania STEELS standards. *PhD Science*, which aligns with the Next Generation Science Standards, does not explicitly cover technology topics.

Grade 1 Standards

3.1.1.A Life Science—From Molecules to Organisms: Structures and Processes

Performance Expectation	Aligned *PhD Science* Lessons*
Use 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.	Level 1 M1 L1–21, 27–29

3.1.1.B Life Science—From Molecules to Organisms: Structures and Processes

Performance Expectation	Aligned *PhD Science* Lessons
Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.	Level 1 M1 L24–29

3.1.1.C Life Science—Heredity: Inheritance and Variation of Traits

Performance Expectation	Aligned *PhD Science* Lessons
Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents.	Level 1 M1 L22–23, 26–29

3.2.1.A Physical Science—Waves and Their Applications in Technologies for Information Transfer

Performance Expectation	Aligned *PhD Science* Lessons
Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.	Level 1 M3 L1–17, 26–29

* **Key:** Module (M), Lesson (L), More to the Story lesson (MttS)

3.2.1.B Physical Science—Waves and Their Applications in Technologies for Information Transfer

Performance Expectation	Aligned *PhD Science* Lessons
Make observations to construct an evidence-based account that objects can be seen only when illuminated.	Level 1 M2 L1–9, 21–23

3.2.1.C Physical Science—Waves and Their Applications in Technologies for Information Transfer

Performance Expectation	Aligned *PhD Science* Lessons
Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light.	Level 1 M2 L1–3, 10–23

3.2.1.D Physical Science—Waves and Their Applications in Technologies for Information Transfer

Performance Expectation	Aligned *PhD Science* Lessons
Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.	Level 1 M3 L18–29

3.3.1.A Earth and Space Science—Earth's Place in the Universe

Performance Expectation	Aligned *PhD Science* Lessons
Use observations of the sun, moon, and stars to describe patterns that can be predicted.	Level 1 M4 L1–8, 14–25

3.3.1.B Earth and Space Science—Earth's Place in the Universe

Performance Expectation	Aligned *PhD Science* Lessons
Make observations at different times of year to relate the amount of daylight to the time of year.	Level 1 M4 L9–13, 23–25

Science and Engineering Practices

Asking Questions and Defining Problems	Aligned *PhD Science* Lessons
Ask questions based on observations to find more information about the natural and/or designed world(s).	Level 1 M1 L1–3 Level 1 M2 L1–3 Level 1 M3 L1–3 Level 1 M4 L1–3, 14–16
Define a simple problem that can be solved through the development of a new or improved object or tool.	Level 1 M1 L11–15

Developing and Using Models	Aligned *PhD Science* Lessons
Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).	Level 1 M1 L1–8 Level 1 M2 L1–7, 10–23 Level 1 M3 L7, 11–13 Level 1 M4 L1–3, 7–8

Planning and Carrying Out Investigations	Aligned *PhD Science* Lessons
Plan and conduct investigations collaboratively to produce evidence to answer a question.	Level 1 M1 L19–20 Level 1 M2 L15–18
Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons.	Level 1 M2 L4–12, 15–18, 20–23 Level 1 M3 L1–7, 11–13, 18–19 Level 1 M4 L4–6, 14–16, 19–21

Analyzing and Interpreting Data	Aligned *PhD Science* Lessons
Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions.	Level 1 M1 L16–21, 27–29 Level 1 M2 L1–9 Level 1 M3 L10 Level 1 M4 L4–6, 9–13
Analyze data from tests of an object or tool to determine if it works as intended.	Level 1 M3 L8–9

Constructing Explanations and Designing Solutions	Aligned *PhD Science* Lessons
Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.	Level 1 M1 L7–8, 16–17, 22–23, 26–29 Level 1 M2 L4–7, 21–23 Level 1 M3 L4–6, 14, 26–29
Use tools and/or materials provided to design and/or build a device that solves a specific problem or a solution to a specific problem.	Level 1 M1 L11–15
Generate and/or compare multiple solutions to a problem.	Level 1 M3 L21–25

Obtaining, Evaluating, and Communicating Information	Aligned *PhD Science* Lessons
Read grade-appropriate texts and/or use media to obtain scientific information to determine and describe patterns in the natural world.	Level 1 M1 L24–25 Level 1 M3 L18–19 Level 1 M4 L9–13
Compare and/or combine across complex texts and/or other reliable media to support the engagement in other scientific and/or engineering practices.	Level 1 M1 L1–3, 4–6, 24–25 Level 1 M2 L4–7, 8–9 Level 1 M3 L1–3, 14, 15–16 Level 1 M4 L1–3, 9–13, 14–16
Communicate information with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.	Level 1 M1 L27–29 Level 1 M2 L21–23 Level 1 M3 L26–29 Level 1 M4 L23–25

Disciplinary Core Ideas

Physical Science

Waves and Their Applications in Technologies for Information Transfer

PS4.A: Wave Properties	**Aligned *PhD Science* Lessons**
Sound can make matter vibrate, and vibrating matter can make sound.	Level 1 M3 L1–17, 26–29

PS4.B: Electromagnetic Radiation	**Aligned *PhD Science* Lessons**
Objects can be seen if light is available to illuminate them or if they give off their own light.	Level 1 M2 L1–9, 21–23
Some materials allow light to pass through them, others allow only some light through, and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam.	Level 1 M2 L1–3, 10–23

PS4.C: Information Technologies and Instrumentation	**Aligned *PhD Science* Lessons**
People also use a variety of devices to communicate (send and receive information) over long distances.	Level 1 M3 L18–29

Life Science

From Molecules to Organisms: Structures and Processes

LS1.A: Structure and Function	Aligned *PhD Science* Lessons
All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water, and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow.	Level 1 M1 L1–15, 27–29

LS1.B: Growth and Development of Organisms	Aligned *PhD Science* Lessons
Adult plants and animals can have young. In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring to survive.	Level 1 M1 L24–29

LS1.D: Information Processing	Aligned *PhD Science* Lessons
Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs.	Level 1 M1 L16–21, 27–29

Heredity: Inheritance and Variation of Traits

LS3.A: Inheritance of Traits	Aligned *PhD Science* Lessons
Young animals are very much, but not exactly, like their parents. Plants also are very much, but not exactly, like their parents.	Level 1 M1 L22–23, 26–29

LS3.B: Variation of Traits	Aligned *PhD Science* Lessons
Individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways.	Level 1 M1 L22–23, 27–29

Earth and Space Science

Earth's Place in the Universe

ESS1.A: The Universe and Its Stars	Aligned *PhD Science* Lessons
Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted.	Level 1 M4 L1–8, 14–25

ESS1.B: Earth and the Solar System	Aligned *PhD Science* Lessons
Seasonal patterns of sunrise and sunset can be observed, described, and predicted.	Level 1 M4 L9–13, 23–25

Engineering, Technology, and Applications of Science

ETS1.A: Defining and Delimiting Engineering Problems	Aligned *PhD Science* Lessons
A situation that people want to change or create can be approached as a problem to be solved through engineering. In solving the problem, there may be different parts that need to connect. Such problems may have many acceptable solutions.	Level 1 M1 L11–15
Asking questions, making observations, and gathering information are helpful in thinking about problems.	Level 1 M1 L11–15
Before beginning to design a solution, it is important to clearly understand the problem.	Level 1 M1 L11–15

ETS1.B: Developing Possible Solutions	Aligned *PhD Science* Lessons
Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	Level 1 M3 L21–25

ETS1.C: Optimizing the Design Solution	Aligned *PhD Science* Lessons
Because there is always more than one possible solution to a problem, it is useful to compare and test designs.	Level 1 M3 L21–25

Crosscutting Concepts

Patterns	**Aligned *PhD Science* Lessons**
Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.	Level 1 M1 L1–6, 16–29 Level 1 M2 L1–9, 21–23 Level 1 M3 L1–7, 11–13, 17–20, 26–29 Level 1 M4 L1–25

Cause and Effect	**Aligned *PhD Science* Lessons**
Simple tests can be designed to gather evidence to support or refute student ideas about causes.	Level 1 M2 L13–14 Level 1 M3 L7, 15–16

Structure and Function	**Aligned *PhD Science* Lessons**
The shape and stability of structures of natural and designed objects are related to their function(s).	Level 1 M1 L4–15, 27–29 Level 1 M3 L8–9

Connections to Nature of Science

Scientific Investigations Use a Variety of Methods	**Aligned *PhD Science* Lessons**
Science investigations begin with a question.	Level 1 M2 L15–18
Scientists use different ways to study the world.	Level 1 M4 L4–6

Scientific Knowledge Is Based on Empirical Evidence	**Aligned *PhD Science* Lessons**
Scientists look for patterns and order when making observations about the world.	Level 1 M1 L24–25 Level 1 M2 L10–12

Scientific Knowledge Assumes an Order and Consistency in Natural Systems	**Aligned *PhD Science* Lessons**
Science assumes natural events happen today as they happened in the past.	Level 1 M4 L9–13
Many events are repeated.	Level 1 M4 L9–13

Connections to Engineering, Technology, and Applications of Science

Influence of Engineering, Technology, and Science on Society and the Natural World	Aligned *PhD Science* Lessons
Every human-made product is designed by applying some knowledge of the natural world and is built by using natural materials.	Level 1 M1 L10–15
People depend on various technologies in their lives; human life would be very different without technology.	Level 1 M3 L20

PhD Science® K–2 Curriculum Correlation to Pennsylvania Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic (STEELS) Standards: Level 2

The *PhD Science* Level 2 curriculum fully aligns with the Grade 2 science and engineering standards in the Pennsylvania STEELS standards. *PhD Science*, which aligns with the Next Generation Science Standards, does not explicitly cover technology topics.

Grade 2 Standards

3.1.2.A Life Science—Ecosystems: Interactions, Energy, and Dynamics

Performance Expectation	Aligned *PhD Science* Lessons*
Plan and conduct an investigation to determine if plants need sunlight and water to grow.	Level 2 M3 L1–7, 25–29

3.1.2.B Life Science—Ecosystems: Interactions, Energy, and Dynamics

Performance Expectation	Aligned *PhD Science* Lessons
Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.	Level 2 M3 L8–29

3.1.2.C Life Science—Biological Evolution: Unity and Diversity

Performance Expectation	Aligned *PhD Science* Lessons
Make observations of plants and animals to compare the diversity of life in different habitats.	Level 2 M4 L1–3, 7–25

* **Key:** Module (M), Lesson (L), More to the Story lesson (MttS)

3.2.2.A Physical Science—Matter and Its Interactions

Performance Expectation	Aligned *PhD Science* Lessons
Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.	Level 2 M1 L1–9, 12–16, 19, 23, 29–31 Level 2 M2 L3–4, 14–17

3.2.2.B Physical Science—Matter and Its Interactions

Performance Expectation	Aligned *PhD Science* Lessons
Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.	Level 2 M1 L20–31

3.2.2.C Physical Science—Matter and Its Interactions

Performance Expectation	Aligned *PhD Science* Lessons
Make 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.	Level 2 M1 L10–11, 29–31

3.2.2.D Physical Science—Matter and Its Interactions

Performance Expectation	Aligned *PhD Science* Lessons
Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.	Level 2 M1 L14–19, 29–31

3.3.2.A Earth and Space Science—Earth's Place in the Universe

Performance Expectation	Aligned *PhD Science* Lessons
Use information from several sources to provide evidence that Earth events can occur quickly or slowly.	Level 2 M2 L18–24

3.3.2.B Earth and Space Science—Earth's Systems

Performance Expectation	Aligned *PhD Science* Lessons
Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.	Level 2 M2 L1–17, 20, 22–24

3.3.2.C Earth and Space Science—Earth's Systems

Performance Expectation	Aligned *PhD Science* Lessons
Develop a model to represent the shapes and kinds of land and bodies of water in an area.	Level 2 M2 L1–2, 5–6 Level 2 M4 L1–6, 11–16, 20–21, 23–25

3.3.2.D Earth and Space Science—Earth's Systems

Performance Expectation	Aligned *PhD Science* Lessons
Obtain information to identify where water is found on Earth and that it can be solid or liquid.	Level 2 M4 L1–6, 16, 22–25

Science and Engineering Practices

Asking Questions and Defining Problems	Aligned *PhD Science* Lessons
Ask questions based on observations to find more information about the natural and/or designed world(s).	Level 2 M1 L1–3 Level 2 M2 L1–2 Level 2 M3 L1–2 Level 2 M4 L1–3
Define a simple problem that can be solved through the development of a new or improved object or tool.	Level 2 M3 L14–18

Developing and Using Models	Aligned *PhD Science* Lessons
Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).	Level 2 M1 L1–3, 14–16, 19, 29–31 Level 2 M2 L1–2, 14–17, 20–24 Level 2 M3 L1–6, 8–12, 19–20, 23–29 Level 2 M4 L1–3, 7–8
Develop a simple model based on evidence to represent a proposed object or tool.	Level 2 M3 L14–18

Planning and Carrying Out Investigations	Aligned *PhD Science* Lessons
Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.	Level 2 M2 L8–12 Level 2 M3 L3–7 Level 2 M4 L17–19
Make observations (firsthand or from media) to collect data which can be used to make comparisons.	Level 2 M1 L1–3, 29–31 Level 2 M2 L1–6, 14–19 Level 2 M3 L3–6, 8–11, 13, 21–22, 25–29 Level 2 M4 L16–19

Analyzing and Interpreting Data	Aligned *PhD Science* Lessons
Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions.	Level 2 M1 L4–11 Level 2 M2 L5–6, 8–9 Level 2 M3 L19–20 Level 2 M4 L22–25
Analyze data from tests of an object or tool to determine if it works as intended.	Level 2 M1 L20–22, 24–28 Level 2 M3 L14–18

Constructing Explanations and Designing Solutions	Aligned *PhD Science* Lessons
Make observations (firsthand or from media) from several sources to construct an evidence-based account for natural phenomena.	Level 2 M1 L8–9, 12–13, 17–19, 23, 29–31 Level 2 M2 L3–4, 7, 13, 22–24 Level 2 M4 L23–25
Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem.	Level 2 M1 L24–28
Generate and/or compare multiple solutions to a problem.	Level 2 M2 L8–12, 14–17

Engaging in Argument from Evidence	Aligned *PhD Science* Lessons
Construct an argument with evidence to support a claim.	Level 2 M2 L3–4, 10–13, 21–24 Level 2 M4 L16

Obtaining, Evaluating, and Communicating Information	Aligned *PhD Science* Lessons
Read grade-appropriate texts and/or use media to obtain scientific information to describe patterns in the natural world.	Level 2 M2 L1–2, 14–17
Compare and/or combine across complex texts and/or other reliable media to support the engagement in other scientific and/or engineering practices.	Level 1 M1 L1–3, 12–13, 19–22, 24–28 Level 1 M2 L1–2, 5–6, 10–12 Level 1 M3 L1–2, 8–10, 21–22 Level 1 M4 L1–3, 11–16
Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question.	Level 2 M2 L5–6, 18–19 Level 2 M4 L4–9, 11–16, 23–25
Communicate information with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.	Level 2 M1 L29–31 Level 2 M2 L22–24 Level 2 M3 L8–12, 14–20, 25–29 Level 2 M4 L23–25

Disciplinary Core Ideas

Physical Science

PS1 Matter and Its Interactions

PS1.A: Structure and Properties of Matter	Aligned *PhD Science* Lessons
Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties.	Level 2 M1 L1–16, 19, 23, 29–31 Level 2 M2 L3–4, 14–17
Different properties are suited to different purposes.	Level 2 M1 L20–31
A great variety of objects can be built up from a small set of pieces.	Level 2 M1 L10–11, 24–31

PS1.B: Chemical Reactions	Aligned *PhD Science* Lessons
Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not.	Level 2 M1 L14–19, 29–31

Life Science

Ecosystems: Interactions, Energy, and Dynamics

LS2.A: Interdependent Relationships in Ecosystems	Aligned *PhD Science* Lessons
Plants depend on water and light to grow.	Level 2 M3 L1–7, 25–29
Plants depend on animals for pollination or to move their seeds around.	Level 2 M3 L8–29

LS4.D: Biodiversity and Humans	Aligned *PhD Science* Lessons
There are many different kinds of living things in any area, and they exist in different places on land and in water.	Level 2 M4 L1–3, 7–25

Earth and Space Science

Earth's Place in the Universe

ESS1.C: The History of Planet Earth	Aligned *PhD Science* Lessons
Some events happen very quickly; others occur very slowly over a time period much longer than one can observe.	Level 2 M2 L18–24

Earth's Systems

ESS2.A: Earth Materials and Systems	Aligned *PhD Science* Lessons
Wind and water can change the shape of the land.	Level 2 M2 L1–17, 20, 22–24

ESS2.B: Plate Tectonics and Large-Scale System Interactions	Aligned *PhD Science* Lessons
Maps show where things are located. One can map the shapes and kinds of land and water in any area.	Level 2 M2 L1–2, 5–6 Level 2 M4 L1–6, 11–16, 20–21, 23–25

ESS2.C: The Roles of Water in Earth's Surface Processes	Aligned *PhD Science* Lessons
Water is found in the oceans, rivers, lakes, and ponds. Water exists as solid ice and in liquid form.	Level 2 M4 L1–6, 16, 22–25

Engineering, Technology, and Applications of Science

ETS1.A: Defining and Delimiting Engineering Problems	Aligned *PhD Science* Lessons
A situation that people want to change or create can be approached as a problem to be solved through engineering. In solving the problem, there may be different parts that need to connect. Such problems may have many acceptable solutions.	Level 2 M1 L24–28 Level 2 M2 L8–12
Asking questions, making observations, and gathering information are helpful in thinking about problems.	Level 2 M1 L24–28
Before beginning to design a solution, it is important to clearly understand the problem.	Level 2 M1 L24–28

ETS1.B: Developing Possible Solutions	Aligned *PhD Science* Lessons
Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	Level 2 M3 L14–18

ETS1.C: Optimizing the Design Solution	Aligned *PhD Science* Lessons
Because there is always more than one possible solution to a problem, it is useful to compare and test designs.	Level 2 M2 L8–12, 14–17

Crosscutting Concepts

Patterns	Aligned *PhD Science* Lessons
Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.	Level 2 M1 L4–9 Level 2 M2 L1–2, 5–6 Level 2 M4 L1–8, 11–15, 20–21, 23–25

Cause and Effect	Aligned *PhD Science* Lessons
Events have causes that generate observable patterns.	Level 2 M1 L14–19, 29–31 Level 2 M2 L20–21 Level 2 M3 L8–11
Simple tests can be designed to gather evidence to support or refute student ideas about causes.	Level 2 M1 L14–18 Level 2 M2 L8–12 Level 2 M3 L3–7

Systems and System Models	Aligned *PhD Science* Lessons
Systems in the natural and designed world have parts that work together.	Level 2 M2 L8–12, 14–17 Level 2 M4 L7–16, 23–25

Energy and Matter	Aligned *PhD Science* Lessons
Objects may break into smaller pieces and be put together into larger pieces or change shapes.	Level 2 M1 L10–11, 29–31 Level 2 M2 L3–4, 8–13, 22–24

Structure and Function	Aligned *PhD Science* Lessons
The shape and stability of structures of natural and designed objects are related to their function(s).	Level 2 M1 L24–28 Level 2 M2 L14–17 Level 2 M3 L8–11, 14–22

Stability and Change	Aligned *PhD Science* Lessons
Things may change slowly or rapidly.	Level 2 M2 L18–24

Connections to Nature of Science

Scientific Knowledge Is Based on Empirical Evidence	Aligned *PhD Science* Lessons
Scientists look for patterns and order when making observations about the world.	Level 2 M4 L11–13, 17–21

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena	Aligned *PhD Science* Lessons
Science searches for cause and effect relationships to explain natural events.	Level 2 M2 L10–12

Science Addresses Questions About the Natural and Material World	Aligned *PhD Science* Lessons
Scientists study the natural and material world.	Level 2 M1 L20–22, 29–31 Level 2 M2 L1–4, 22–24 Level 2 M3 L25–29 Level 2 M4 L23–25

Connections to Engineering, Technology, and Applications of Science

Influence of Engineering, Technology, and Science on Society and the Natural World	Aligned *PhD Science* Lessons
Every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world.	Level 2 M2 L14–17 Level 2 M3 L14–18
Developing and using technology has impacts on the natural world.	Level 2 M2 L8–9

PhD Science® K–2 Curriculum Correlation to Pennsylvania STEELS Standards—Technology & Engineering, and Environmental Literacy & Sustainability: Levels K–2

The *PhD Science* K–2 curriculum mostly aligns with the K–2 Technology & Engineering, and Environmental Literacy & Sustainability standards in the Pennsylvania STEELS standards. *PhD Science*, which aligns with the Next Generation Science Standards, does not explicitly cover technology topics. *PhD Science* views technology as machinery and equipment developed from the application of scientific knowledge.

3.4.K–2.A Environmental Literacy and Sustainability: Agricultural and Environmental Systems and Resources

Performance Expectation	Aligned *PhD Science* Lessons*
Categorize ways people harvest, re-distribute, and use natural resources.	Level K M3 L1–3, 9–29 Level K M4 L11–13 Level 2 M3 L14–18

3.4.K–2.B Environmental Literacy and Sustainability: Agricultural and Environmental Systems and Resources

Performance Expectation	Aligned *PhD Science* Lessons
Examine how people from different cultures and communities, including one's own, interact and express their beliefs about nature.	Level K M1 L3, 10–11, 21, 24, 26, 27 Level K M3 L23–26 Level K M1 MttS Level 1 M1 L11–15 Level 1 M4 L2–3, 8, 18, 22 Level 2 M4 L1–2 Level 2 M4 MttS

* **Key:** Module (M), Lesson (L), More to the Story lesson (MttS)

3.4.K–2.C Environmental Literacy and Sustainability: Environmental Literacy Skills

Performance Expectation	Aligned *PhD Science* Lessons
Explain ways that places differ in their physical characteristics, their meaning, and their value and/or importance.	Level K M3 L1–3, 11–12, 19–21, 23–25, 27 Level K M4 L3–5 Level 1 M1 L1, 11–15 Level 2 M2 L1–2, 5–7 Level 2 M4 L1–6, 11–16, 20–25

3.4.K–2.D Environmental Literacy and Sustainability: Environmental Literacy Skills

Performance Expectation	Aligned *PhD Science* Lessons
Plan and carry out an investigation to address an issue in their local environment and community.	Level K M4 L1, 11–16, 18–24 Level 1 M2 L13–14 Level 2 M2 L14–17

3.5.K–2.A Technology and Engineering: Applying, Maintaining, and Assessing Technological Products and Systems

Performance Expectation	Aligned *PhD Science* Lessons
Identify and use everyday symbols.	Level K M1 L3–7, 10–11, 19, 22–25, 27 Level 1 M4 L9, 12, 13 Level 2 M4 L7–10, 21

3.5.K–2.B Technology and Engineering: Applying, Maintaining, and Assessing Technological Products and Systems

Performance Expectation	Aligned *PhD Science* Lessons
Describe qualities of everyday products.	Level K M1 L12–16 Level K M4 L18–25 Level 1 M1 L10–15 Level 2 M1 L20–28 *PhD Science* does not explicitly identify items as everyday products.

3.5.K–2.C Technology and Engineering: Impacts of Technology

Performance Expectation	Aligned *PhD Science* Lessons
Explain ways that technology helps with everyday tasks.	Level K M4 L18–19 Level 1 M3 L20 Level 2 M2 L10–12

3.5.K–2.D Technology and Engineering: Impacts of Technology

Performance Expectation	Aligned *PhD Science* Lessons
Select ways to reduce, reuse, and recycle resources in daily life.	Level K M4 L18–25 Level 1 M3 L1–3

3.5.K–2.E Technology and Engineering: Impacts of Technology

Performance Expectation	Aligned *PhD Science* Lessons
Illustrate helpful and harmful effects of technology.	Level K M2 L17–20 Level K M4 L18–19 Level 1 M3 L20 Level 2 M3 L14–18

3.5.K–2.F Technology and Engineering: Influence of Society on Technological Development

Performance Expectation	Aligned *PhD Science* Lessons
Investigate the use of technologies in the home and community.	Level K M2 L17–20 Level 1 M2 L13–14 Level 1 M3 L18–25 Level 2 M2 L14–17

3.5.K–2.G Technology and Engineering: Nature and Characteristics of Technology and Engineering

Performance Expectation	Aligned *PhD Science* Lessons
Explain the tools and techniques that people use to help them do things.	Level K M1 L5, 17–20 Level 1 M2 L16, 22 Level 1 M4 L1 Level 2 M3 L3–6, L14–18

3.5.K–2.H Technology and Engineering: Influence of Society on Technological Development

Performance Expectation	Aligned *PhD Science* Lessons
Explain the needs and wants of individuals and societies.	Level K M1 L10 Level K M3 L22–26 Level 1 M2 L13–14 Level 2 M1 L24–28 The *PhD Science* K–2 curriculum does not explicitly address needs and wants.

3.5.K–2.I Technology and Engineering: Impacts of Technology

Performance Expectation	Aligned *PhD Science* Lessons
Compare simple technologies to evaluate their impacts.	Level K M1 L12–16 Level K M2 L17–20 Level 1 M2 L15–17 Level 2 M1 L24–28 Level 2 M3 L14–18

3.5.K–2.J Technology and Engineering: Impacts of Technology

Performance Expectation	Aligned *PhD Science* Lessons
Design new technologies that could improve their daily lives.	Level K M1 L12–16 Level 1 M1 L10–15 Level 1 M2 L13–14 Level 1 M3 L18–25 Level 2 M1 L24–28

3.5.K–2.K Technology and Engineering: Core Concepts of Technology and Engineering

Performance Expectation	Aligned *PhD Science* Lessons
Safely use tools to complete tasks.	Level K M2 L17–20 Level 1 M1 L11–15 Level 2 M3 L3–6, L14–18

3.5.K–2.L Technology and Engineering: Influence of Society on Technological Development

Performance Expectation	Aligned *PhD Science* Lessons
Explore how technologies are developed to meet individual and societal needs and wants.	Level K M1 L12–16 Level K M2 L17–20 Level 1 M2 L13–14 Level 1 M3 L18–25 Level 2 M1 L24–28 Level 2 M2 L14–17 The *PhD Science* K–2 curriculum does not explicitly address needs and wants.

3.5.K–2.M Technology and Engineering: Design in Technology and Engineering Education

Performance Expectation	Aligned *PhD Science* Lessons
Demonstrate essential skills of the engineering design process.	Level K M1 L12–16 Level K M2 L17–20 Level K M4 L20–24 Level 1 M1 L11–15 Level 1 M3 L21–25 Level 2 M1 L24–28 Level 2 M2 L8–12 Level 2 M3 L14–18

3.5.K–2.N Technology and Engineering: Applying, Maintaining, and Assessing Technological Products and Systems

Performance Expectation	Aligned *PhD Science* Lessons
Analyze how things work.	Level K M3 L1–3, 9–13, 19–21, 23–25, 27–29 Level K M4 L1–9, 11–16 Level 1 M3 L21–25 Level 2 M2 L8–12, 14–17

3.5.K–2.O Technology and Engineering: Design in Technology and Engineering Education

Performance Expectation	Aligned *PhD Science* Lessons
Illustrate that there are different solutions to a design and that none are perfect.	Level K M4 L20–24 Level 1 M3 L21–25 Level 2 M2 L8–12, 14–17

3.5.K–2.P Technology and Engineering: Design in Technology and Engineering Education

Performance Expectation	Aligned *PhD Science* Lessons
Discuss that all designs have different characteristics that can be described.	Level K M2 L17–20 Level 1 M3 L21–25 Level 2 M3 L14–18

3.5.K–2.Q Technology and Engineering: Design in Technology and Engineering Education

Performance Expectation	Aligned *PhD Science* Lessons
Apply skills necessary for making in design.	Level K M2 L17–20 Level 1 M3 L21–25 Level 2 M3 L14–18

3.5.K–2.R Technology and Engineering: Integration of Knowledge, Technologies, and Practices

Performance Expectation	Aligned *PhD Science* Lessons
Draw connections between technology and human experiences.	Level K M1 L12–16 Level K M2 L17–20 Level 1 M2 L13–14 Level 1 M3 L18–25 Level 2 M1 L24–28 *PhD Science* does not explicitly address the connections between technology and human experiences.

3.5.K–2.S Technology and Engineering: Design in Technology and Engineering Education

Performance Expectation	Aligned *PhD Science* Lessons
Apply design concepts, principles, and processes through play and exploration.	Level K M1 L12–16 Level 1 M1 L11–15 Level 2 M1 L24–28 Level 2 M2 L8–12

3.5.K–2.T Technology and Engineering: Design in Technology and Engineering Education

Performance Expectation	Aligned *PhD Science* Lessons
Demonstrate that designs have requirements.	Level K M1 L12–16 Level 1 M1 L11–15 Level 2 M1 L24–28

3.5.K–2.U Technology and Engineering: Design in Technology and Engineering Education

Performance Expectation	Aligned *PhD Science* Lessons
Explain that design is a response to wants and needs.	Level K M1 L12–16 Level 1 M1 L11–15 Level 2 M1 L24–28 Level 2 M2 L8–12 The *PhD Science* K–2 curriculum does not explicitly address needs and wants.

3.5.K–2.V Technology and Engineering: Core Concepts of Technology and Engineering

Performance Expectation	Aligned *PhD Science* Lessons
Explain that materials are selected for use because they possess desirable properties and characteristics.	Level K M1 L12–16 Level K M2 L17–20 Level 1 M1 L11–15 Level 1 M2 L13–14 Level 2 M1 L20–31 Level 2 M3 L14–18

3.5.K–2.W Technology and Engineering: Integration of Knowledge, Technologies, and Practices

Performance Expectation	Aligned *PhD Science* Lessons
Apply concepts and skills from technology and engineering activities that reinforce concepts and skills across multiple content areas.	Level K M1 L12–16 Level K M2 L17–20 Level 2 M2 L15–17 Level 2 M3 L14–18

3.5.K–2.X Technology and Engineering: Core Concepts of Technology and Engineering

Performance Expectation	Aligned *PhD Science* Lessons
Develop a plan in order to complete a task.	Level K M2 L7–8, 10–15 Level K M3 L4–8 Level 1 M3 L21–25 Level 2 M2 L8–12 Level 2 M3 L3–7 Level 2 M4 L17–19

3.5.K–2.Y Technology and Engineering: History of Technology

Performance Expectation	Aligned *PhD Science* Lessons
Discuss how the way people live and work has changed throughout history because of technology.	Level K M1 L2, 12, 27, 29–30 Level K M3 L23–26, 28–29 Level K M4 L18–19 Level 1 M2 L13–14 Level 1 M4 L1, 7–8 Level 2 M2 L10–12

3.5.K–2.Z Technology and Engineering: Core Concepts of Technology and Engineering

Performance Expectation	Aligned *PhD Science* Lessons
Illustrate how systems have parts or components that work together to accomplish a goal.	Level K M3 L1–3, 9–13, 19–21, 23–25, 27–29 Level K M4 L1–9, 11–16 Level 1 M1 L7–8 Level 1 M2 L1–3, L10–23 Level 1 M3 L21–25 Level 2 M2 L8–12, 14–17 Level 2 M4 L7–16, 23–25

3.5.K–2.AA Technology and Engineering: Nature and Characteristics of Technology and Engineering

Performance Expectation	Aligned *PhD Science* Lessons
Demonstrate that creating can be done by anyone.	Level K M1 L6–7 Level K M4 L18–25 Level 1 M3 L21–25 Level 2 M3 L14–18

3.5.K–2.BB Technology and Engineering: Nature and Characteristics of Technology and Engineering

Performance Expectation	Aligned *PhD Science* Lessons
Compare the natural world and human-made world.	Level K M4 L18–19 Level 1 M1 L10–15 Level 1 M2 L13–14 Level 1 M4 L1–3 Level 2 M2 L14–17 Level 2 M3 L14–18

3.5.K–2.CC Technology and Engineering: Nature and Characteristics of Technology and Engineering

Performance Expectation	Aligned *PhD Science* Lessons
Discuss the roles of scientists, engineers, technologists, and others who work with technology.	Level K M1 L1–2, 12–16, 28–30 Level K M2 L21–23 Level K M3 L27–29 Level K M4 L26–28 Level 1 M1 L10–12, 27–29 Level 1 M2 L21–23 Level 1 M3 L26–29 Level 1 M4 L7–8, 23–25 Level 2 M1 L20–22, 29–31 Level 2 M2 L1–4, 22–24 Level 2 M3 L25–29 Level 2 M4 L23–25

3.5.K–2.DD Technology and Engineering: Core Concepts of Technology and Engineering

Performance Expectation	Aligned *PhD Science* Lessons
Collaborate effectively as a member of a team.	Level K M2 L7–8, 10–15 Level K M3 L4–8 Level 1 M1 L19–20 Level 1 M2 L15–18 Level 2 M2 L8–12 Level 2 M3 L3–7 Level 2 M4 L17–19

Technology and Engineering Practices (TEP)

Communication	Aligned PhD Science Lessons
Learns that humans have many ways to communicate	Level K M1 L25–26 Level K M4 L1–2 Level 1 M3 L18–19, 20, 21–25, 26–29 Level 2 M2 L14–17 Level 2 M3 L8–11, 14–18, 20

Attention to Ethics	Aligned PhD Science Lessons
Learns that use of technology affects humans and the environment	Level K M4 11–16, 18–24 Level 1 M3 L20 Level 2 M2 L8–9, 10–12, 14–17 Level 2 M3 L14–18

Critical Thinking	Aligned PhD Science Lessons
Engages in listening, questioning, and discussing	Level K M1 L3, 11–16, 21, 27–30 Level K M2 L3, 9, 17–23 Level K M3 L3, 13, 21, 26–29 Level K M4 L2, 10, 17–28 Level 1 M1 L2, 9–15, 21, 26–28 Level 1 M2 L3, 9, 20–23 Level 1 M3 L3, 10, 17, 21–29 Level 1 M4 L3, 7, 18, 22–25 Level 2 M1 L3, 7, 13, 19, 23–31 Level 2 M2 L2, 7, 13–17, 21–24 Level 2 M3 L2, 7, 13–18, 24–29 Level 2 M4 L3, 10, 16, 22–25

Making and Doing	Aligned PhD Science Lessons
Learns to use tools and materials to accomplish a task	Level K M1 L4–7, 12–16, 17–20 Level K M2 L17–20 Level K M4 L20–24 Level 1 M1 L11–15 Level 1 M3 L21–25 Level 1 M4 L1–3 Level 2 M1 L24–28 Level 2 M2 L14–17 Level 2 M3 L14–18

Systems Thinking	Aligned PhD Science Lessons
Learns that human-designed things are connected	Level K M4 L14–16 Level 1 M2 L1–3, 10–23 Level 2 M2 L8–9, 10–12, 14–17

Creativity	Aligned PhD Science Lessons
Learns that humans create products and ways of doing things	Level K M1 L12–16 Level K M2 L17–20 Level K M4 L20–24 Level 1 M1 L11–15 Level 1 M3 L21–25 Level 2 M1 L24–28 Level 2 M3 L14–18

Collaboration	Aligned PhD Science Lessons
Learns to share technological products and ideas	Level K M1 L12–16 Level K M2 L17–20 Level K M4 L20–24 Level 1 M1 L11–15 Level 1 M3 L21–25 Level 2 M1 L24–28 Level 2 M2 L14–17 Level 2 M3 L14–18

Optimism	Aligned PhD Science Lessons
Sees opportunities for making technologies better	Level K M2 L17–20 Level 1 M3 L21–25 Level 2 M3 L17

PhD Science® 3–5 Curriculum Correlation to Pennsylvania Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic (STEELS) Standards: Level 3

The *PhD Science* Level 3 curriculum fully aligns with the Grade 3 science and engineering standards in the Pennsylvania STEELS standards. *PhD Science*, which aligns with the Next Generation Science Standards, does not explicitly cover technology topics.

Grade 3 Standards

3.1.3.A Life Science—From Molecules to Organisms: Structures and Processes

Performance Expectation	Aligned *PhD Science* Lessons*
Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.	Level 3 M3 L7–8, 23–28

3.1.3.B Life Science—Ecosystems: Interactions, Energy, and Dynamics

Performance Expectation	Aligned *PhD Science* Lessons
Construct an argument that some animals form groups that help members survive.	Level 3 M2 L13–15, 26–28

3.1.3.C Life Science—Heredity: Inheritance and Variation of Traits

Performance Expectation	Aligned *PhD Science* Lessons
Analyze and interpret 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.	Level 3 M3 L1–6, 14–18, 26–28

3.1.3.D Life Science—Heredity: Inheritance and Variation of Traits

Performance Expectation	Aligned *PhD Science* Lessons
Use evidence to support the explanation that traits can be influenced by the environment.	Level 3 M3 L9–13, 19–20, 26–28

* **Key:** Module (M), Lesson (L), More to the Story lesson (MttS)

3.1.3.E Life Science—Biological Evolution: Unity and Diversity

Performance Expectation	Aligned *PhD Science* Lessons
Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.	Level 3 M2 L1–8, 26–28

3.1.3.F Life Science—Biological Evolution: Unity and Diversity

Performance Expectation	Aligned *PhD Science* Lessons
Use 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.	Level 3 M3 L21–28

3.1.3.G Life Science—Biological Evolution: Unity and Diversity

Performance Expectation	Aligned *PhD Science* Lessons
Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.	Level 3 M2 L1–2, 9–12, 16–19, 22–28

3.1.3.H Life Science—Biological Evolution: Unity and Diversity

Performance Expectation	Aligned *PhD Science* Lessons
Make a claim supported by evidence 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.	Level 3 M2 L16–28

3.2.3.A Physical Science—Motion and Stability: Forces and Interactions

Performance Expectation	Aligned *PhD Science* Lessons
Make and communicate observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.	Level 3 M4 L1–9, 28–30

3.2.3.B Physical Science—Motion and Stability: Forces and Interactions

Performance Expectation	Aligned *PhD Science* Lessons
Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.	Level 3 M4 L10–18, 28–30

3.2.3.C Physical Science—Motion and Stability: Forces and Interactions

Performance Expectation	Aligned *PhD Science* Lessons
Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.	Level 3 M4 L19–21, 28–30

3.2.3.D Physical Science—Motion and Stability: Forces and Interactions

Performance Expectation	Aligned *PhD Science* Lessons
Define a simple design problem that can be solved by applying scientific ideas about magnets.	Level 3 M4 L22–30

3.3.3.A Earth and Space Science—Earth's Systems

Performance Expectation	Aligned *PhD Science* Lessons
Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.	Level 3 M1 L1–15, 19–20, 27–29

3.3.3.B Earth and Space Science—Earth's Systems

Performance Expectation	Aligned *PhD Science* Lessons
Obtain and combine information to describe climates in different regions of the world.	Level 3 M1 L11–15, 27–29

3.3.3.C Earth and Space Science—Earth and Human Activity

Performance Expectation	Aligned *PhD Science* Lessons
Make a claim supported by evidence about the merit of a design solution that reduces the impacts of a weather-related hazard.	Level 3 M1 L1–3, 16–29

Science and Engineering Practices

Asking Questions and Defining Problems	Aligned *PhD Science* Lessons
Ask questions that can be investigated based on patterns such as cause and effect relationships.	Level 3 M1 L1–3 Level 3 M2 L1–2 Level 3 M3 L1–3 Level 3 M4 L1–3, 7–9, 28–30
Define a simple problem that can be solved through the development of a new or improved object or tool.	Level 3 M1 L21–26, 28–29 Level 3 M4 L23–27

Developing and Using Models	Aligned *PhD Science* Lessons
Develop models to describe phenomena.	Level 3 M1 L1–3, 19–20 Level 3 M2 L9–12, 27–28 Level 3 M3 L7–11, 21–25, 27–28 Level 3 M4 L1–3, 17–18, 28–30
Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.	Level 4 M3 L7–11 Level 4 M4 L10–13, 18–24 Level 5 M3 L12–13 Level 5 M4 L9–12

Planning and Carrying Out Investigations	Aligned *PhD Science* Lessons
Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.	Level 3 M4 L7–9, 15–16, 23–27, 29–30
Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.	Level 3 M2 L4–5 Level 3 M4 L7–18, 29–30

Analyzing and Interpreting Data	Aligned *PhD Science* Lessons
Represent data in tables and/or various graphical displays (bar graphs and pictographs) to reveal patterns that indicate relationships.	Level 3 M1 L4–12 Level 3 M3 L7–8, 27–28 Level 3 M4 L4–9
Analyze and interpret data to make sense of phenomena, using logical reasoning.	Level 3 M1 L11–15, 19–20, 27–29 Level 3 M2 L3–8, 16–19, 27–28 Level 3 M3 L4–6, 14–18, 27–28
Analyze data to refine a problem statement or the design of a proposed object, tool, or process.	Level 4 M4 L14–17

Using Mathematics and Computational Thinking	Aligned *PhD Science* Lessons
Organize simple data sets to reveal patterns that suggest relationships.	Level 3 M1 L4–12 Level 3 M2 L3, 16–19 Level 3 M3 L7–8

Constructing Explanations and Designing Solutions	Aligned *PhD Science* Lessons
Construct an explanation of observed relationships (e.g., the distribution of plants in the backyard).	Level 3 M2 L6–8 Level 3 M3 L26–28 Level 3 M4 L10–14
Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.	Level 3 M1 L13–15, 18 Level 3 M2 L6–8, 26–28 Level 3 M3 L9–11, 14–15, 21–28 Level 3 M4 L10–14, 19–21, 28–30

Engaging in Argument from Evidence	Aligned *PhD Science* Lessons
Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation.	Level 5 M4 L5–6
Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions.	Level 4 M3 L21–23 Level 5 M2 L3–5, 21–23, 25–26
Construct and/or support an argument with evidence, data, and/or a model.	Level 3 M2 L9–15, 27–28 Level 3 M3 L16–18
Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.	Level 3 M1 L21–26, 28–29 Level 3 M2 L20–21

Obtaining, Evaluating, and Communicating Information	Aligned *PhD Science* Lessons
Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence.	Level 3 M2 L13–15 Level 3 M4 L22
Compare and/or combine across complex texts and/or other reliable media to support the engagement in other scientific and/or engineering practices.	Level 3 M2 L13–15
Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.	Level 3 M1 L11–17, 28–29
Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.	Level 3 M2 L20–21

Disciplinary Core Ideas

Physical Science

Motion and Stability: Forces and Interactions

PS2.A: Forces and Motion	Aligned *PhD Science* Lessons
Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion.	Level 3 M4 L10–18, 28–30
The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it.	Level 3 M4 L1–9, 28–30

PS2.B: Types of Interactions	Aligned *PhD Science* Lessons
Objects in contact exert forces on each other.	Level 3 M4 L10–18, 28–30
Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.	Level 3 M4 L19–30

Life Science

From Molecules to Organisms: Structures and Processes

LS1.B: Growth and Development of Organisms	Aligned *PhD Science* Lessons
Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles.	Level 3 M3 L7–8, 23–28

Ecosystems: Interactions, Energy, and Dynamics

LS2.C: Ecosystem Dynamics, Functioning, and Resilience	Aligned *PhD Science* Lessons
When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die.	Level 3 M2 L16–28

LS2.D: Social Interactions and Group Behavior	Aligned *PhD Science* Lessons
Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size.	Level 3 M2 L13–15, 26–28

Heredity: Inheritance and Variation of Traits

LS3.A: Inheritance of Traits	Aligned *PhD Science* Lessons
Many characteristics of organisms are inherited from their parents.	Level 3 M3 L14–18, 26–28
Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment.	Level 3 M3 L9–13, 19–20, 26–28

LS3.B: Variation of Traits	Aligned *PhD Science* Lessons
Different organisms vary in how they look and function because they have different inherited information.	Level 3 M3 L1–6, 14–18, 23–28
The environment also affects the traits that an organism develops.	Level 3 M3 L9–13, 19–20

Biological Evolution: Unity and Diversity

LS4.A: Evidence of Common Ancestry and Diversity	Aligned *PhD Science* Lessons
Some kinds of plants and animals that once lived on Earth are no longer found anywhere.	Level 3 M2 L6–8, 26–28
Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments.	Level 3 M2 L1–8, 26–28

LS4.B: Natural Selection	Aligned *PhD Science* Lessons
Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing.	Level 3 M3 L21–28

LS4.C: Adaptation	Aligned *PhD Science* Lessons
For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.	Level 3 M2 L1–2, 9–12, 16–19, 22–28

LS4.D: Biodiversity and Humans	Aligned *PhD Science* Lessons
Populations live in a variety of habitats, and change in those habitats affects the organisms living there.	Level 3 M2 L16–28

Earth and Space Science

Earth Systems

ESS2.D:Weather and Climate	Aligned *PhD Science* Lessons
Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.	Level 3 M1 L1–15, 19–20, 27–29
Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years.	Level 3 M1 L11–15, 27–29

Earth and Human Activity

ESS3.B: Natural Hazards	Aligned *PhD Science* Lessons
A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts.	Level 3 M1 L1–3, 16–29

Engineering, Technology, and Applications of Science

ETS1.A: Defining and Delimiting Engineering Problems	Aligned *PhD Science* Lessons
Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.	Level 3 M1 L21–26

ETS1.B: Developing Possible Solutions	Aligned *PhD Science* Lessons
Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions.	Level 3 M1 L22–23
At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.	Level 3 M2 L22–25
Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.	Level 3 M4 L23–27

ETS1.C: Optimizing the Design Solution	Aligned *PhD Science* Lessons
Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	Level 3 M4 L23–27

National Assessment of Educational Progress (NAEP) Technology and Engineering Literacy (TEL)

NAEP D.8.1	Aligned *PhD Science* Lessons
Science is the systematic investigation of the natural world. Technology is any modification of the environment to satisfy people's needs and wants. Engineering is the process of creating or modifying technologies and is constrained by physical laws and cultural norms, and economic resources.	Level 3 M1 L21–26 Level 3 M2 L20–21

NAEP D.8.6	Aligned *PhD Science* Lessons
Engineering design is a systematic and creative process for meeting challenges. Often there are several solutions to a design challenge. Each one might be better in some way than the others. For example, one solution might be safer, while another might cost less.	Level 3 M2 L22–25

Crosscutting Concepts

Patterns	Aligned *PhD Science* Lessons
Similarities and differences in patterns can be used to sort and classify natural phenomena.	Level 3 M3 L1–8, 14–15, 27–28 Level 3 M4 L29–30
Patterns of change can be used to make predictions.	Level 3 M1 L11–15, 19–20, 27–29 Level 3 M3 L7–8 Level 3 M4 L1–9, 28–30

Cause and Effect	Aligned *PhD Science* Lessons
Cause and effect relationships are routinely identified, tested, and used to explain change.	Level 3 M1 L16–18, 21–26, 28–29 Level 3 M2 L9–12, 16–28 Level 3 M3 L9–13, 19–25, 27–28 Level 3 M4 L1–3, 10–30

Scale, Proportion, and Quantity	Aligned *PhD Science* Lessons
Observable phenomena exist from very short to very long time periods.	Level 3 M2 L1–2, 27–28 Level 3 M3 L1–3

Systems and System Models	Aligned PhD Science Lessons
A system can be described in terms of its components and their interactions.	Level 3 M1 L1–3, 16–20 Level 3 M2 L6–15, 20–28 Level 3 M3 L9–11 Level 3 M4 L1–30

Structure and Function	Aligned *PhD Science* Lessons
Different materials have different substructures, which can sometimes be observed.	Level 3 M2 L1–3

Stability and Change	Aligned *PhD Science* Lessons
Change is measured in terms of differences over time and may occur at different rates.	Level 3 M1 L4–15, 27–29 Level 3 M2 L16–19 Level 3 M3 L7–8, 12–13, 19–20, 26–28

Connections to Nature of Science

Scientific Investigations Use a Variety of Methods	Aligned *PhD Science* Lessons
Scientific investigations use a variety of methods, tools, and techniques.	Level 3 M4 L15–16

Scientific Knowledge Is Based on Empirical Evidence	Aligned *PhD Science* Lessons
Science findings are based on recognizing patterns.	Level 3 M3 L7–8 Level 3 M4 L4–6

Scientific Knowledge Assumes an Order and Consistency in Natural Systems	Aligned *PhD Science* Lessons
Science assumes consistent patterns in natural systems.	Level 3 M2 L4–5

Science Is a Human Endeavor	Aligned *PhD Science* Lessons
Science affects everyday life.	Level 3 M1 L21–26

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology	**Aligned *PhD Science* Lessons**
Scientific discoveries about the natural world can often lead to new and improved technologies, which are developed through the engineering design process.	Level 3 M4 L23–27
Knowledge of relevant scientific concepts and research findings is important in engineering.	Level 3 M2 L22–25

Influence of Engineering, Technology, and Science on Society and the Natural World	**Aligned *PhD Science* Lessons**
Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.	Level 3 M2 L22–25

PhD Science® 3–5 Curriculum Correlation to Pennsylvania Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic (STEELS) Standards: Level 4

The *PhD Science* Level 4 curriculum fully aligns with the Grade 4 science and engineering standards in the Pennsylvania STEELS standards. *PhD Science*, which aligns with the Next Generation Science Standards, does not explicitly cover technology topics.

Grade 4 Standards

3.1.4.A Life Science—From Molecules to Organisms: Structures and Processes

Performance Expectation	Aligned PhD Science Lessons*
Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.	Level 4 M3 L1–6, 20, 26–31

3.1.4.B Life Science—From Molecules to Organisms: Structures and Processes

Performance Expectation	Aligned PhD Science Lessons
Use 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.	Level 4 M3 L1–6, 15–25, 29–31

3.2.4.A Physical Science—Energy

Performance Expectation	Aligned PhD Science Lessons
Use evidence to construct an explanation relating the speed of an object to the energy of that object.	Level 4 M2 L6–7, 24–26

3.2.4.B Physical Science—Energy

Performance Expectation	Aligned PhD Science Lessons
Make and communicate observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.	Level 4 M2 L1–5, 10–11, 24–26

* **Key:** Module (M), Lesson (L), More to the Story lesson (MttS)

3.2.4.C Physical Science—Energy

Performance Expectation	Aligned PhD Science Lessons
Ask questions and predict outcomes about the changes in energy that occur when objects collide.	Level 4 M2 L8–9, 24–26

3.2.4.D Physical Science—Energy

Performance Expectation	Aligned PhD Science Lessons
Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.	Level 4 M2 L12–26

3.2.4.E Physical Science—Waves and Their Applications in Technologies for Information Transfer

Performance Expectation	Aligned PhD Science Lessons
Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.	Level 4 M3 L7–14, 29–31

3.2.4.F Physical Science—Waves and Their Applications in Technologies for Information Transfer

Performance Expectation	Aligned PhD Science Lessons
Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.	Level 4 M4 L1–17, 25–27

3.2.4.G Physical Science—Waves and Their Applications in Technologies for Information Transfer

Performance Expectation	Aligned PhD Science Lessons
Generate and compare multiple solutions that use patterns to transfer information.	Level 4 M4 L18–27

3.3.4.A Earth and Space Science—Earth's Place in the Universe

Performance Expectation	Aligned PhD Science Lessons
Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.	Level 4 M1 L1–5, 19–20, 25–27

3.3.4.B Earth and Space Science—Earth's Systems

Performance Expectation	Aligned PhD Science Lessons
Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.	Level 4 M1 L6–11, 25–27

3.3.4.C Earth and Space Science—Earth's Systems

Performance Expectation	Aligned PhD Science Lessons
Analyze and interpret data from maps to describe patterns of Earth's features.	Level 4 M1 L18–20, 25–27

3.3.4.D Earth and Space Science—Earth and Human Activity

Performance Expectation	Aligned PhD Science Lessons
Obtain and combine information to describe that energy and fuels are derived from natural resources and that their uses affect the environment.	Level 4 M1 L21–27

3.3.4.E Earth and Space Science—Earth and Human Activity

Performance Expectation	Aligned PhD Science Lessons
Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.	Level 4 M1 L12–17, 25–27

Science and Engineering Practices

Asking Questions and Defining Problems	**Aligned *PhD Science* Lessons**
Ask questions that can be investigated based on patterns such as cause and effect relationships.	Level 4 M1 L1–2, 23 Level 4 M2 L1–3, 8–9, 11, 25–26 Level 4 M3 L1–3, 6 Level 4 M4 L1–2

Developing and Using Models	**Aligned *PhD Science* Lessons**
Develop a model using an analogy, example, or abstract representation to describe a scientific principle.	Level 4 M1 L1–2, 26–27 Level 4 M2 L1–3, 8–11, 25–26 Level 4 M3 L1–3, 7–14, 30–31 Level 4 M4 L1–2
Develop a model to describe phenomena.	Level 4 M1 L1–2, 26–27 Level 4 M2 L1–3, 8–9, 25–26 Level 4 M3 L1–3 Level 4 M4 L1–6
Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.	Level 4 M3 L7–11 Level 4 M4 L10–13, 18–24

Planning and Carrying Out Investigations	**Aligned *PhD Science* Lessons**
Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.	Level 4 M1 L8–11 Level 4 M2 L6–7 Level 4 M3 L15–19 Level 4 M4 L7–8, 18–21
Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.	Level 4 M1 L6–11, 21–22 Level 4 M2 L10–14 Level 4 M3 L15–19 Level 4 M4 L9, 26–27

Analyzing and Interpreting Data	Aligned *PhD Science* Lessons
Analyze and interpret data to make sense of phenomena, using logical reasoning.	Level 4 M1 L12–20, 23–24, 26–27 Level 4 M2 L25–26 Level 4 M4 L10–13
Analyze data to refine a problem statement or the design of a proposed object, tool, or process.	Level 4 M4 L14–17

Using Mathematics and Computational Thinking	Aligned *PhD Science* Lessons
Organize simple data sets to reveal patterns that suggest relationships.	Level 3 M1 L4–12 Level 3 M2 L3, 16–19 Level 3 M3 L7–8 Level 5 M4 L25–26

Constructing Explanations and Designing Solutions	Aligned *PhD Science* Lessons
Construct an explanation of observed relationships (e.g., the distribution of plants in the backyard).	Level 4 M1 L6–7, 26–27 Level 4 M2 L25–26 Level 4 M3 L30–31 Level 4 M4 L18–21, 26–27
Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.	Level 4 M1 L3–5, 25–27 Level 4 M2 L4–5, 15–16, 24–26 Level 4 M3 L4–5, 24–25, 29–31 Level 4 M4 L25–27
Identify the evidence that supports particular points in an explanation.	Level 4 M1 L3–5, 10, 18, 21–22, 25–27
Apply scientific ideas to solve design problems.	Level 4 M2 L17–23 Level 4 M4 L14–17, 26–27
Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.	Level 4 M1 L12–17 Level 4 M4 L14–17, 22–24

Engaging in Argument from Evidence	Aligned *PhD Science* Lessons
Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation.	Level 5 M4 L5–6
Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions.	Level 4 M3 L21–23
Construct and/or support an argument with evidence, data, and/or a model.	Level 4 M3 L21–23, 26–28, 30–31
Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.	Level 3 M1 L21–26, 28–29 Level 3 M2 L20–21 Level 5 M3 L19–23

Obtaining, Evaluating, and Communicating Information	Aligned *PhD Science* Lessons
Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence.	Level 4 M1 L3–5 Level 4 M3 L30–31 Level 4 M4 L22–24
Compare and/or combine across complex texts and/or other reliable media to support the engagement in other scientific and/or engineering practices.	Level 3 M2 L13–15 Level 5 M2 L6–7, 20 Level 5 M3 L25–27
Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.	Level 4 M1 L3–5, 23–24 Level 4 M3 L4–6, 10–11, 20–23, 26–28
Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.	Level 4 M1 L23–24

Disciplinary Core Ideas

Physical Science

Waves and Their Applications in Technologies for Information Transfer

PS4.A: Wave Properties	Aligned *PhD Science* Lessons
Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach.	Level 4 M3 L7–14, 29–31
Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks).	Level 4 M3 L7–14, 29–31

PS4.B: Electromagnetic Radiation	Aligned *PhD Science* Lessons
An object can be seen when light reflected from its surface enters the eyes.	Level 4 M4 L1–17, 25–27

PS4.C: Information Technologies and Instrumentation	Aligned *PhD Science* Lessons
Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa.	Level 4 M4 L18–27

Energy

PS3.A: Definitions of Energy	Aligned *PhD Science* Lessons
The faster a given object is moving, the more energy it possesses.	Level 4 M2 L6–9, 12–16, 24–26
Energy can be moved from place to place by moving objects or through sound, light, or electric currents.	Level 4 M2 L1–3, 10–11, 15–16, 24–26

PS3.B: Conservation of Energy and Energy Transfer	Aligned *PhD Science* Lessons
Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced.	Level 4 M2 L1–5, 8–9, 24–26
Light also transfers energy from place to place.	Level 4 M2 L10–11, 24–26
Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy.	Level 4 M2 L1–3, 10–26

PS3.C: Relationship Between Energy and Forces	Aligned *PhD Science* Lessons
When objects collide, the contact forces transfer energy so as to change the objects' motions.	Level 4 M2 L8–9, 24–26

PS3.D: Energy in Chemical Processes and Everyday Life	Aligned *PhD Science* Lessons
The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use.	Level 4 M2 L12–14, 24–26

Life Science

From Molecules to Organisms: Structures and Processes

LS1.A: Structure and Function	Aligned *PhD Science* Lessons
Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.	Level 4 M3 L1–6, 20, 26–31

LS1.D: Information Processing	Aligned *PhD Science* Lessons
Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions.	Level 4 M3 L1–6, 15–25, 29–31

Earth and Space Science

Earth's Place in the Universe

ESS1.C: The History of Planet Earth	Aligned *PhD Science* Lessons
Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed.	Level 4 M1 L1–5, 19–20, 25–27

Earth's Systems

ESS2.A: Earth Materials and Systems	Aligned *PhD Science* Lessons
Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around.	Level 4 M1 L6–11, 25–27

ESS2.B: Plate Tectonics and Large-Scale System Interactions	Aligned *PhD Science* Lessons
The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth.	Level 4 M1 L18–20, 25–27

ESS2.E: Biogeology	Aligned *PhD Science* Lessons
Living things affect the physical characteristics of their regions.	Level 4 M1 L6–11, 25–27

Earth and Human Activity

ESS3.A: Natural Resources	Aligned *PhD Science* Lessons
Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.	Level 4 M1 L21–27

ESS3.B: Natural Hazards	Aligned *PhD Science* Lessons
A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts.	Level 4 M1 L12–17, 25–27

Engineering, Technology, and Applications of Science

ETS1.A: Defining and Delimiting Engineering Problems	Aligned *PhD Science* Lessons
Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.	Level 4 M2 L17–23

ETS1.B: Developing Possible Solutions	Aligned *PhD Science* Lessons
Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions.	Level 4 M1 L12–17 Level 4 M4 L14–17
At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.	Level 4 M1 L12–17 Level 4 M4 L14–17
Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.	Level 4 M1 L12–17 Level 4 M4 L14–17

ETS1.C: Optimizing the Design Solution	Aligned *PhD Science* Lessons
Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	Level 4 M4 L14–17

National Assessment of Educational Progress (NAEP) Technology and Engineering Literacy (TEL)

NAEP D.8.1	Aligned *PhD Science* Lessons
Science is the systematic investigation of the natural world. Technology is any modification of the environment to satisfy people's needs and wants. Engineering is the process of creating or modifying technologies and is constrained by physical laws and cultural norms, and economic resources.	Level 4 M1 L12–17, 21–24 Level 4 M2 L1–3, 17–23

NAEP D.8.6	Aligned *PhD Science* Lessons
Engineering design is a systematic and creative process for meeting challenges. Often there are several solutions to a design challenge. Each one might be better in some way than the others. For example, one solution might be safer, while another might cost less.	Level 4 M1 L12–17 Level 4 M4 L14–17

Crosscutting Concepts

Patterns	Aligned *PhD Science* Lessons
Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena.	Level 4 M3 L7–9, 30–31 Level 4 M4 L22–27
Patterns of change can be used to make predictions.	Level 4 M4 L1–2
Patterns can be used as evidence to support an explanation.	Level 4 M1 L1–5, 18–20, 26–27 Level 4 M2 L4–5, 8–11, 24–26 Level 4 M3 L1–3, 7–11, 20, 24–31 Level 4 M4 L3–4, 7–8, 14–17

Cause and Effect	Aligned *PhD Science* Lessons
Cause and effect relationships are routinely identified, tested, and used to explain change.	Level 4 M1 L6–17, 21–27 Level 4 M2 L1–7, 10–14, 24–26 Level 4 M3 L6–23, 30–31 Level 4 M4 L3–13, 18–21, 25–27

Scale, Proportion, and Quantity	Aligned *PhD Science* Lessons
Observable phenomena exist from very short to very long time periods.	Level 4 M1 L3–5

Systems and System Models	Aligned PhD Science Lessons
A system can be described in terms of its components and their interactions.	Level 4 M1 L1–2, 12–17 Level 4 M2 L1–11, 24–26 Level 4 M3 L7–9, 15–19, 21–23, 26–28, 30–31 Level 4 M4 L1–6, 10–13, 18–27

Energy and Matter	Aligned *PhD Science* Lessons
Energy can be transferred in various ways and between objects.	Level 4 M2 L1–3, 8–26 Level 4 M3 L10–19, 30–31

Structure and Function	Aligned *PhD Science* Lessons
Different materials have different substructures, which can sometimes be observed.	Level 4 M3 L4–5, 20, 24–25 Level 4 M4 L7–9, 25–27

Stability and Change	Aligned *PhD Science* Lessons
Change is measured in terms of differences over time and may occur at different rates.	Level 4 M1 L3–11, 18–20, 25–27

Connections to Nature of Science

Scientific Knowledge Is Based on Empirical Evidence	Aligned PhD Science Lessons
Science findings are based on recognizing patterns.	Level 4 M3 L7–9

Scientific Knowledge Assumes an Order and Consistency in Natural Systems	Aligned PhD Science Lessons
Science assumes consistent patterns in natural systems.	Level 4 M1 L6–7

Science Is a Human Endeavor	Aligned PhD Science Lessons
Most scientists and engineers work in teams.	Level 4 M2 L17–23
Science affects everyday life.	Level 4 M2 L1–3

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology	Aligned PhD Science Lessons
Knowledge of relevant scientific concepts and research findings is important in engineering.	Level 4 M1 L12–17 Level 4 M4 L22–24

Influence of Engineering, Technology, and Science on Society and the Natural World	Aligned PhD Science Lessons
People's needs and wants change over time, as do their demands for new and improved technologies.	Level 4 M1 L23–24 Level 4 M2 L17–23
Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands.	Level 4 M1 L12–17 Level 4 M2 L15–16 Level 4 M4 L14–17

PhD Science® 3–5 Curriculum Correlation to Pennsylvania Science, Technology & Engineering, and Environmental Literacy & Sustainability Academic (STEELS) Standards: Level 5

The *PhD Science* Level 5 curriculum fully aligns with the Grade 5 science and engineering standards in the Pennsylvania STEELS standards. *PhD Science*, which aligns with the Next Generation Science Standards, does not explicitly cover technology topics.

Grade 5 Standards

3.1.5.A Life Science—From Molecules to Organisms: Structures and Processes

Performance Expectation	Aligned *PhD Science* Lessons*
Support an argument that plants get the materials they need for growth chiefly from air and water.	Level 5 M2 L3–5, 24–26

3.1.5.B Life Science—Ecosystems: Interactions, Energy, and Dynamics

Performance Expectation	Aligned *PhD Science* Lessons
Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.	Level 5 M2 L1–2, 6–14, 20, 24–26

3.2.5.A Physical Science—Matter and Its Interactions

Performance Expectation	Aligned *PhD Science* Lessons
Develop a model to describe that matter is made of particles too small to be seen.	Level 5 M1 L5–10, 23–26

3.2.5.B Physical Science—Matter and Its Interactions

Performance Expectation	Aligned *PhD Science* Lessons
Make and communicate observations and measurements to identify materials based on their properties.	Level 5 M1 L1–4, 11–17, 23–26

* **Key:** Module (M), Lesson (L), More to the Story lesson (MttS)

3.2.5.C Physical Science—Matter and Its Interactions

Performance Expectation	Aligned *PhD Science* Lessons
Interpret and analyze data to make decisions about how to utilize materials based on their properties.	Level 5 M1 L15–17

3.2.5.D Physical Science—Matter and Its Interactions

Performance Expectation	Aligned *PhD Science* Lessons
Measure and graph 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.	Level 5 M1 L9–17, 23–26

3.2.5.E Physical Science—Matter and Its Interactions

Performance Expectation	Aligned *PhD Science* Lessons
Conduct an investigation to determine whether the mixing of two or more substances results in new substances.	Level 5 M1 L1–2, 13–26

3.2.5.F Physical Science—Motion and Stability: Forces and Interactions

Performance Expectation	Aligned *PhD Science* Lessons
Support an argument that the gravitational force exerted by Earth on objects is directed down.	Level 5 M4 L3–4, 24–26

3.2.5.G Physical Science—Energy

Performance Expectation	Aligned *PhD Science* Lessons
Use 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.	Level 5 M2 L15–19, 24–26

3.3.5.A Earth and Space Science—Earth's Place in the Universe

Performance Expectation	Aligned *PhD Science* Lessons
Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth.	Level 5 M4 L18–19, 24–26

3.3.5.B Earth and Space Science—Earth's Place in the Universe

Performance Expectation	Aligned *PhD Science* Lessons
Represent 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.	Level 5 M4 L1–2, 5–17, 20–26

3.3.5.C Earth and Space Science—Earth's Systems

Performance Expectation	Aligned *PhD Science* Lessons
Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.	Level 5 M3 L1–3, 6–13, 19–27

3.3.5.D Earth and Space Science—Earth's Systems

Performance Expectation	Aligned *PhD Science* Lessons
Describe and graph the amounts and percentages of [salt] water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.	Level 5 M3 L4–5, 19–27

3.3.5.E Earth and Space Science—Earth and Human Activity

Performance Expectation	Aligned *PhD Science* Lessons
Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.	Level 5 M3 L14–18, 24–27

3.3.5.F Earth and Space Science—Earth and Human Activity

Performance Expectation	Aligned *PhD Science* Lessons
Generate and design possible solutions to a current environmental issue, threat, or concern.	Level 5 M2 L21–23 Level 5 M3 L19–23

Science and Engineering Practices

Developing and Using Models	**Aligned *PhD Science* Lessons**
Develop a model using an example to describe a scientific principle.	Level 5 M1 L7–8 Level 5 M2 L20, 25–26 Level 5 M3 L6–8, 10–11, 24–27 Level 5 M4 L3–4, 24–26
Develop and/or use models to describe phenomena.	Level 5 M1 L1–2, 9–10, 13–14, 23–26 Level 5 M2 L1–2, 6–7, 14 Level 5 M3 L1–3, 9, 12–16, 25–27 Level 5 M4 L13, 20–26
Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.	Level 5 M3 L12–13 Level 5 M4 L9–12

Planning and Carrying Out Investigations	**Aligned *PhD Science* Lessons**
Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.	Level 5 M1 L18–22 Level 5 M2 L3–5 Level 5 M4 L25–26
Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.	Level 5 M1 L13–14, 24–26 Level 5 M3 L10–11 Level 5 M4 L18–19

Analyzing and Interpreting Data	**Aligned *PhD Science* Lessons**
Represent data in graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships.	Level 5 M2 L3–5, 10–11 Level 5 M3 L4–5, 14–16 Level 5 M4 L14–15
Analyze and interpret data to make sense of phenomena, using logical reasoning.	Level 5 M1 L15–17, 24–26 Level 5 M2 L8–9, 12–13, 15–17, 25–26 Level 5 M3 L4–5, 25–27
Analyze data to refine a problem statement or the design of a proposed object, tool, or process.	Level 4 M4 L14–17

Using Mathematics and Computational Thinking	Aligned *PhD Science* Lessons
Organize simple data sets to reveal patterns that suggest relationships.	Level 5 M4 L25–26
Describe and/or measure and graph quantities such as area, volume, and weight to address scientific and engineering questions and problems.	Level 5 M1 L3–4, 15–17 Level 5 M3 L10–11, 24–27

Constructing Explanations and Designing Solutions	Aligned *PhD Science* Lessons
Construct an explanation of observed relationships (e.g., the distribution of plants in the backyard).	Level 5 M2 L12–13, 25–26 Level 5 M4 L22–26
Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.	Level 5 M1 L5–6, 23–26 Level 5 M2 L15–17, 24–26 Level 5 M3 L17–18, 25–27 Level 5 M4 L24–26

Engaging in Argument from Evidence	Aligned *PhD Science* Lessons
Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation.	Level 5 M4 L5–6
Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions.	Level 5 M2 L3–5, 21–23, 25–26
Construct and/or support an argument with evidence, data, and/or a model.	Level 5 M1 L3–4, 24–26 Level 5 M2 L3–5, 8–11, 25–26 Level 5 M3 L25–27 Level 5 M4 L13–17, 20–21, 24–26
Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.	Level 5 M3 L19–23

Obtaining, Evaluating, and Communicating Information	Aligned *PhD Science* Lessons
Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence.	Level 5 M2 L10–11, 18–19, 25–26
Compare and/or combine across complex texts and/or other reliable media to support the engagement in other scientific and/or engineering practices.	Level 5 M2 L6–7, 20 Level 5 M3 L25–27
Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.	Level 5 M3 L9, 14–16, 19–27
Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.	Level 3 M2 L20–21 Level 4 M1 L23–24

Disciplinary Core Ideas

Physical Science

Motion and Stability: Forces and Interactions

PS1.A: Structure and Properties of Matter	Aligned *PhD Science* Lessons
Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and that are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects.	Level 5 M1 L5–10, 23–26
The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish.	Level 5 M1 L9–17, 23–26
Measurements of a variety of properties can be used to identify materials.	Level 5 M1 L1–4, 11–17, 23–26

PS1.B: Chemical Reactions	Aligned *PhD Science* Lessons
When two or more different substances are mixed, a new substance with different properties may be formed.	Level 5 M1 L1–2, 15–26
No matter what reaction or change in properties occurs, the total weight of the substances does not change.	Level 5 M1 L9–17, 23–26

PS2.B: Types of Interactions	Aligned *PhD Science* Lessons
The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.	Level 5 M4 L3–4, 24–26

Energy

PS3.D: Energy in Chemical Processes and Everyday Life	Aligned *PhD Science* Lessons
The energy released from food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water).	Level 5 M2 L6–7, 15–19, 24–26

Life Science

From Molecules to Organisms: Structures and Processes

LS1.C: Organization for Matter and Energy Flow in Organisms	Aligned *PhD Science* Lessons
Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion.	Level 5 M2 L8–9, 15–19, 24–26
Plants acquire their material for growth chiefly from air and water.	Level 5 M2 L3–5, 24–26

Ecosystems: Interactions, Energy, and Dynamics

LS2.A: Interdependent Relationships in Ecosystems	Aligned *PhD Science* Lessons
The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants' parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem.	Level 5 M2 L1–2, 8–14, 20, 24–26

LS2.B: Cycles of Matter and Energy Transfer in Ecosystems	Aligned *PhD Science* Lessons
Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment and release waste matter (gas, liquid, or solid) back into the environment.	Level 5 M2 L6–7, 10–14, 24–26

Earth and Space Science

Earth's Place in the Universe

ESS1.A: The Universe and Its Stars	Aligned *PhD Science* Lessons
The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth.	Level 5 M4 L18–19, 24–26

ESS1.B: Earth and the Solar System	Aligned *PhD Science* Lessons
The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year.	Level 5 M4 L1–2, 5–17, 20–26

Earth's Systems

ESS2.A: Earth Materials and Systems	Aligned *PhD Science* Lessons
Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather.	Level 5 M3 L1–13, 24–27

ESS2.C: The Roles of Water in Earth's Surface Processes	Aligned *PhD Science* Lessons
Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.	Level 5 M3 L4–5, 24–27

Earth and Human Activity

ESS3.C: Human Impacts on Earth Systems	Aligned *PhD Science* Lessons
Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, oceans, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.	Level 5 M3 L14–27

Engineering, Technology, and Applications of Science

ETS1.A: Defining and Delimiting Engineering Problems	Aligned *PhD Science* Lessons
Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.	Level 5 M2 L21–23

ETS1.B: Developing Possible Solutions	Aligned *PhD Science* Lessons
Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions.	Level 5 M3 L19–23
At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.	Level 5 M2 L21–23 Level 5 M3 L19–23
Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.	Level 5 M1 L18–22

ETS1.C: Optimizing the Design Solution	Aligned *PhD Science* Lessons
Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	Level 5 M1 L18–22

National Assessment of Educational Progress (NAEP) Technology and Engineering Literacy (TEL)

NAEP D.8.1	Aligned *PhD Science* Lessons
Science is the systematic investigation of the natural world. Technology is any modification of the environment to satisfy people's needs and wants. Engineering is the process of creating or modifying technologies and is constrained by physical laws and cultural norms, and economic resources.	Level 5 M3 L19–23

NAEP D.8.6	Aligned *PhD Science* Lessons
Engineering design is a systematic and creative process for meeting challenges. Often there are several solutions to a design challenge. Each one might be better in some way than the others. For example, one solution might be safer, while another might cost less.	Level 5 M2 L21–23 Level 5 M3 L19–23

Crosscutting Concepts

Patterns	Aligned *PhD Science* Lessons
Similarities and differences in patterns can be used to sort, classify, communicate, and analyze simple rates of change for natural phenomena.	Level 5 M4 L5–6, 13–17, 22–23
Patterns of change can be used to make predictions.	Level 5 M4 L9–12, 20–21, 24–26

Cause and Effect	Aligned *PhD Science* Lessons
Cause and effect relationships are routinely identified, tested, and used to explain change.	Level 5 M1 L1–2, 5–6, 9–10, 18–22, 24–26 Level 5 M2 L3–7, 12–13, 18–19, 21–23, 25–26 Level 5 M3 L6–8, 12–13, 17–18, 25–27 Level 5 M4 L5–6, 24–26

Scale, Proportion, and Quantity	Aligned *PhD Science* Lessons
Natural objects exist from the very small to the immensely large.	Level 5 M1 L23–26 Level 5 M2 L10–11 Level 5 M3 L4–5, 24–27 Level 5 M4 L18–19, 24–26
Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.	Level 5 M1 L3–4, 13–17, 23–26 Level 5 M3 L1–3, 10–11, 25–27

Systems and System Models	Aligned PhD Science Lessons
A system can be described in terms of its components and their interactions.	Level 5 M1 L3–4, 15–17 Level 5 M2 L1–2, 6–11, 24–26 Level 5 M3 L1–9, 12–13, 19–27 Level 5 M4 L1–2, 7–26

Energy and Matter	Aligned *PhD Science* Lessons
Matter is transported into, out of, and within systems.	Level 5 M2 L10–11, 25–26
Energy can be transferred in various ways and between objects.	Level 5 M1 L13–14 Level 5 M2 L15–19, 24–26 Level 5 M3 L10–11

Structure and Function	Aligned *PhD Science* Lessons
Different materials have different substructures, which can sometimes be observed.	Level 3 M2 L1–3 Level 4 M3 L4–5, 20, 24–25 Level 4 M4 L7–9, 25–27

Stability and Change	Aligned *PhD Science* Lessons
Change is measured in terms of differences over time and may occur at different rates.	Level 5 M1 L1–2, 9–12, 18–26 Level 5 M2 L12–13, 20, 25–26 Level 5 M3 L17–18 Level 5 M4 L5–6, 9–12, 24–26

Connections to Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena	Aligned PhD Science Lessons
Science explanations describe the mechanisms for natural events.	Level 5 M2 L14 Level 5 M4 L1–2, 7–8, 13

Scientific Knowledge Assumes an Order and Consistency in Natural Systems	Aligned PhD Science Lessons
Science assumes consistent patterns in natural systems.	Level 5 M1 L7–8

Science Addresses Questions About the Natural and Material World	Aligned PhD Science Lessons
Science findings are limited to what can be answered with empirical evidence.	Level 5 M3 L10–11 Level 5 M4 L5–8

PhD Science® 3–5 Curriculum Correlation to Pennsylvania STEELS Standards—Technology & Engineering, and Environmental Literacy & Sustainability: Levels 3–5

The *PhD Science* 3–5 curriculum mostly aligns with the 3–5 Technology & Engineering, and Environmental Literacy & Sustainability standards in the Pennsylvania STEELS standards. *PhD Science*, which aligns with the Next Generation Science Standards, does not explicitly cover technology topics. *PhD Science* views technology as machinery and equipment developed from the application of scientific knowledge.

3.4.3–5.A Environmental Literacy and Sustainability: Agricultural and Environmental Systems and Resources

Performance Expectation	Aligned PhD Science Lessons*
Analyze how living organisms, including humans, affect the environment in which they live, and how their environment affects them.	Level 3 M2 L9–12, 16–19 Level 4 M1 L21–22 Level 5 M3 L19–23

3.4.3–5.B Environmental Literacy and Sustainability: Agricultural and Environmental Systems and Resources

Performance Expectation	Aligned PhD Science Lessons
Make a claim about the environmental and social impacts of design solutions and civic actions, including their own actions.	Level 3 M2 L20–21 Level 4 M1 L21–22 Level 5 M3 L19–23

3.4.3–5.C Environmental Literacy and Sustainability: Sustainability and Stewardship

Performance Expectation	Aligned PhD Science Lessons
Examine ways you influence your local environment and community by collecting and displaying data.	Level 3 M2 L16, 21, 22–25

* **Key:** Module (M), Lesson (L), More to the Story lesson (MttS)

3.4.3–5.D Environmental Literacy and Sustainability: Environmental Literacy Skills

Performance Expectation	Aligned PhD Science Lessons
Develop a model to demonstrate how local environmental issues are connected to larger local environment and human systems.	Level 3 M1 L21–26 Level 3 M2 L20–25 Level 4 M1 L21–24 Level 5 M3 L17–23

3.4.3–5.E Environmental Literacy and Sustainability: Sustainability and Stewardship

Performance Expectation	Aligned PhD Science Lessons
Construct an argument to support whether action is needed on a selected environmental issue and propose possible solutions.	Level 3 M2 L21–25 Level 4 M1L21–24 Level 5 M2 L21–23 Level 5 M3 L14–23

3.4.3–5.F Environmental Literacy and Sustainability: Sustainability and Stewardship

Performance Expectation	Aligned PhD Science Lessons
Critique ways that people depend on and change the environment.	Level 3 M1 L21–25 Level 3 M2 L20–21 Level 4 M1 L21–22 Level 5 M3 L19–23

3.4.3–5.G Environmental Literacy and Sustainability: Environmental Literacy Skills

Performance Expectation	Aligned PhD Science Lessons
Investigate how perspectives over the use of resources and the development of technology have changed over time and resulted in conflict over the development of societies and nations.	Level 4 M1 MttS

3.5.3–5.A Technology and Engineering: Applying, Maintaining, and Assessing Technological Products and Systems

Performance Expectation	Aligned PhD Science Lessons
Use appropriate symbols, numbers and words to communicate key ideas about technological products and systems.	Level 4 M2 Level 4 M1 L2, 5, 10–11, 13, 18, 20, 26

3.5.3–5.B Technology and Engineering: Applying, Maintaining, and Assessing Technological Products and Systems

Performance Expectation	Aligned PhD Science Lessons
Examine information to assess the trade–offs of using a product or system.	Level 3 M2 L20–21 Level 4 M1 L23–24 Level 4 M4 L18–24 Level 5 M3 L19–23

3.5.3–5.C Technology and Engineering: Applying, Maintaining, and Assessing Technological Products and Systems

Performance Expectation	Aligned PhD Science Lessons
Follow directions to complete a technological task.	Level 4 M2 L12–14 Level 4 M4 L22–24

3.5.3–5.D Technology and Engineering: Impacts of Technology

Performance Expectation	Aligned PhD Science Lessons
Predict how certain aspects of their daily lives would be different without given technologies.	Level 3 M1 L1–2, 21–26 Level 4 M1 L12–17, 23–24 Level 4 M2 L17–23

3.5.3–5.E Technology and Engineering: Impacts of Technology

Performance Expectation	Aligned PhD Science Lessons
Explain why responsible use of technology requires sustainable management of resources.	Level 4 M1 L21–24 Level 5 M3 L19–23

3.5.3–5.F Technology and Engineering: Impacts of Technology

Performance Expectation	Aligned PhD Science Lessons
Classify resources used to create technologies as either renewable or nonrenewable.	Level 4 M1 L23–24 Level 5 M3 L17–23

3.5.3–5.G Technology and Engineering: Impacts of Technology

Performance Expectation	Aligned PhD Science Lessons
Describe the helpful and harmful effects of technology.	Level 3 M1 L18, 21–26 Level 4 M1 L22–23 Level 4 M2 L17–23 Level 5 M3 L17–23

3.5.3–5.H Technology and Engineering: Influence of Society on Technological Development

Performance Expectation	Aligned PhD Science Lessons
Determine factors that influence changes in a society's technological systems or infrastructure.	Level 3 M2 L22–25 Level 4 M1 L12–17 Level 4 M2 L15–16 Level 4 M4 L14–17 Level 5 M2 L21–23 Level 5 M3 L19–23

3.5.3–5.I Technology and Engineering: Nature and Characteristics of Technology and Engineering

Performance Expectation	Aligned PhD Science Lessons
Design solutions by safely using tools, materials, and skills.	Level 3 M1 L21–25 Level 3 M2 L22–25 Level 3 M4 L23–27 Level 4 M1 L12–17 Level 4 M2 L17–23 Level 4 M4 L14–17 Level 5 M1 L18–22 Level 5 M2 L21–23 Level 5 M3 L19–23

3.5.3–5.J Technology and Engineering: Influence of Society on Technological Development

Performance Expectation	Aligned *PhD Science* Lessons
Explain how technologies are developed or adapted when individual or societal needs and wants change.	Level 3 M1 L21–26 Level 4 M1 L23–24 Level 4 M2 L17–23 Level 5 M2 L21–23

3.5.3–5.K Technology and Engineering: Impacts of Technology

Performance Expectation	Aligned *PhD Science* Lessons
Judge technologies to determine the best one to use to complete a given task or meet a need.	Level 3 M1 L21–26 Level 3 M4 L23–27 Level 4 M1 L12–17 Level 4 M2 L17–23 Level 4 M4 L14–17 Level 5 M3 L19–23

3.5.3–5.L Technology and Engineering: Core Concepts of Technology and Engineering

Performance Expectation	Aligned *PhD Science* Lessons
Demonstrate how tools and machines extend human capabilities, such as holding, lifting, carrying, fastening, separating, and computing.	Level 3 M4 L23–27 Level 4 M4 L19–20, 22–24 Level 5 M4 L7

3.5.3–5.M Technology and Engineering: Design in Technology and Engineering Education

Performance Expectation	Aligned *PhD Science* Lessons
Demonstrate essential skills of the engineering design process.	Level 3 M1 L21–25 Level 3 M2 L22–25 Level 3 M4 L23–27 Level 4 M1 L12–17 Level 4 M2 L17–23 Level 4 M4 L14–17 Level 5 M1 L18–22 Level 5 M2 L21–23 Level 5 M3 L19–23

3.5.3–5.N Technology and Engineering: Applying, Maintaining, and Assessing Technological Products and Systems

Performance Expectation	Aligned *PhD Science* Lessons
Identify why a product or system is not working properly.	Level 4 M2 L17–23 Level 4 M4 L14–17 Level 5 M3 L17–23

3.5.3–5.O Technology and Engineering: Core Concepts of Technology and Engineering

Performance Expectation	Aligned *PhD Science* Lessons
Describe requirements of designing or making a product or system.	Level 3 M1 L21–26 Level 3 M2 L22–25 Level 4 M1 L12–17 Level 5 M3 L17–23

3.5.3–5.P Technology and Engineering: Design in Technology and Engineering Education

Performance Expectation	Aligned *PhD Science* Lessons
Evaluate the strengths and weaknesses of existing design solutions, including their own solutions.	Level 3 M1 L21–25 Level 3 M2 L22–25 Level 3 M4 L23–27 Level 4 M1 L12–17 Level 4 M2 L17–23 Level 4 M4 L14–17 Level 5 M1 L18–22 Level 5 M2 L3–5, 21–23 Level 5 M3 L19–23

3.5.3–5.Q Technology and Engineering: Design in Technology and Engineering Education

Performance Expectation	Aligned *PhD Science* Lessons
Practice successful design skills.	Level 3 M1 L21–25 Level 3 M2 L22–25 Level 3 M4 L23–27 Level 4 M1 L12–17 Level 4 M2 L17–23 Level 4 M4 L14–17 Level 5 M1 L18–22 Level 5 M2 L21–23 Level 5 M3 L19–23

3.5.3–5.R Technology and Engineering: Design in Technology and Engineering Education

Performance Expectation	Aligned *PhD Science* Lessons
Apply tools, techniques, and materials in a safe manner as part of the design process.	Level 3 M1 L21–25 Level 3 M2 L22–25 Level 3 M4 L23–27 Level 4 M1 L12–17 Level 4 M2 L17–23 Level 4 M4 L14–17 Level 5 M1 L18–22 Level 5 M2 L21–23 Level 5 M3 L19–23

3.5.3–5.S Technology and Engineering: Design in Technology and Engineering Education

Performance Expectation	Aligned *PhD Science* Lessons
Illustrate that there are multiple approaches to design.	Level 3 M1 L21–25 Level 3 M2 L22–25 Level 3 M4 L23–27 Level 4 M1 L12–17 Level 4 M2 L17–23 Level 4 M4 L14–17 Level 5 M1 L18–22 Level 5 M2 L21–23 Level 5 M3 L19–23

3.5.3–5.T Technology and Engineering: Design in Technology and Engineering Education

Performance Expectation	Aligned *PhD Science* Lessons
Apply universal principles and elements of design.	Level 1 M3 L18–25 Level 3 M4 L23–27 Level 4 M4 L14–17 In *PhD Science*, student application of universal design principles is implicit.

3.5.3–5.U Technology and Engineering: Design in Technology and Engineering Education

Performance Expectation	Aligned *PhD Science* Lessons
Evaluate designs based on criteria, constraints, and standards.	Level 3 M1 L21–26 Level 3 M2 L22–25 Level 3 M4 23–27 Level 4 M1 L12–17 Level 4 M2 L17–23 Level 4 M4 L14–17 Level 5 M1 L18–22 Level 5 M2 L3–5, 21–23 Level 5 M3 L19–23

3.5.3–5.V Technology and Engineering: Design in Technology and Engineering Education

Performance Expectation	Aligned *PhD Science* Lessons
Interpret how good design improves the human condition.	Level 3 M1 L21–26 Level 4 M1 L12–17 Level 4 M2 L17–23 Level 4 M4 L14–17 Level 5 M3 L19–23

3.5.3–5.W Technology and Engineering: Core Concepts of Technology and Engineering

Performance Expectation	Aligned *PhD Science* Lessons
Describe the properties of different materials.	Level 3 M4 L19–27 Level 4 M4 L1–2, 7–8, 10–13 Level 5 M1 L3–4, 11–12, 18–22

3.5.3–5.X Technology and Engineering: Integration of Knowledge, Technologies, and Practices

Performance Expectation	Aligned *PhD Science* Lessons
Explain how various relationships can exist between technology and engineering and other content areas.	Level 3 M1 L21 Level 3 M2 L23 Level 3 M4 L23–24 Level 4 M1 L12, 15 Level 4 M2 L4, 6–8 Level 4 M4 L14 Level 5 M1 L18 Level 5 M2 L21, 23 Level 5 M3 L19–20, 23

3.5.3–5.Y Technology and Engineering: Core Concepts of Technology and Engineering

Performance Expectation	Aligned *PhD Science* Lessons
Identify the resources needed to get a technical job done, such as people, materials, capital, tools, machines, knowledge, energy, and time.	Level 3 M1 L21–26 Level 3 M4 L23–27 Level 4 M1 L12–17 Level 4 M2 L17–23 Level 4 M4 L14–17 Level 5 M1 L18–22 Level 5 M3 L19–23

3.5.3–5.Z Technology and Engineering: Core Concepts of Technology and Engineering

Performance Expectation	Aligned *PhD Science* Lessons
Create a new product that improves someone's life.	Level 3 M1 L21–25 Level 4 M2 L17–22 Level 5 M3 L19–23

3.5.3–5.AA Technology and Engineering: History of Technology

Performance Expectation	Aligned *PhD Science* Lessons
Create representations of the tools people made, how they cultivated to provide food, made clothing, and built shelters to protect themselves.	Level K M1 L12–16, 28–30 Level 2 M3 L14–18 Level 4 M2 L1–3, 15 Level 5 M3 L19–23

3.5.3–5.BB Technology and Engineering: Core Concepts of Technology and Engineering

Performance Expectation	Aligned *PhD Science* Lessons
Illustrate how, when parts of a system are missing, it may not work as planned.	Level 4 M1 L12–17 Level 4 M2 L10, 14, 17–23 Level 4 M4 L11, 13

3.5.3–5.CC Technology and Engineering: Core Concepts of Technology and Engineering

Performance Expectation	Aligned *PhD Science* Lessons
Describe how a subsystem is a system that operates as a part of another larger system.	Level 3 M1 L17–18 Level 4 M2 L4–5, 15–16 Level 5 M2 L14, 18–19 Level 5 M3 L6–8, 24–27

3.5.3–5.DD Technology and Engineering: Integration of Knowledge, Technologies, and Practices

Performance Expectation	Aligned *PhD Science* Lessons
Demonstrate how simple technologies are often combined to form more complex systems.	Level 3 M4 L7–9, 23–27 Level 4 M2 L8–9, 17–23 Level 4 M4 L18–24 Level 5 M3 L17–23

3.5.3–5.EE Technology and Engineering: Nature and Characteristics of Technology and Engineering

Performance Expectation	Aligned *PhD Science* Lessons
Explain how solutions to problems are shaped by economic, political, and cultural forces.	Level 3 M1 L21–26 Level 3 M2 L22–25 Level 4 M1 L12–17 Level 4 M2 L1–3, 16–23 Level 5 M2 L20–23 Level 5 M3 L17–23 *PhD Science* does not address economic, political, and cultural forces.

3.5.3–5.FF Technology and Engineering: Nature and Characteristics of Technology and Engineering

Performance Expectation	Aligned *PhD Science* Lessons
Compare how things found in nature differ from things that are human-made, noting differences and similarities in how they are produced and used.	Level 4 M1 L23–24 Level 4 M3 L17–18 Level 5 M3 L17–23

3.5.3–5.GG Technology and Engineering:

Performance Expectation	Aligned *PhD Science* Lessons
Describe the unique relationship between science and technology, and how the natural world can contribute to the human-made world to foster innovation.	Level 3 M4 L23–27 Level 4 M2 L1–3, 17–23 Level 5 M3 L17–23

3.5.3–5.HH Technology and Engineering: Nature and Characteristics of Technology and Engineering

Performance Expectation	Aligned *PhD Science* Lessons
Differentiate between the role of scientists, engineers, technologists, and others in creating and maintaining technological systems.	Level 3 M4 L1, 3, 9, 23–27 Level 4 M2 L1–3, 17–23 Level 5 M4 L7, 11, 14, 18, 25

Technology and Engineering Practices (TEP)

Communication	Aligned PhD Science Lessons
Learns that humans have many ways to communicate	Level 3 M1 L1–3, 21–26 Level 3 M2 L13–15 Level 4 M3 L4–5, 12–14, 15–19 Level 4 M4 L10–13, 18–24 Level 5 M4 L9–12

Attention to Ethics	Aligned PhD Science Lessons
Learns that use of technology affects humans and the environment	Level 3 M1 L21–26 Level 4 M1 L21–24 Level 4 M2 L15–16 Level 5 M3 L19–23

Critical Thinking	Aligned PhD Science Lessons
Engages in listening, questioning, and discussing	Level 3 M1 L3, 10, 15–16, 20–29 Level 3 M2 L2, 8, 12–15, 22–28 Level 3 M3 L3, 11, 21, 26–28 Level 3 M4 L3, 9, 16–18, 21, 23–30 Level 4 M1 L2, 9–17, 20, 24–27 Level 4 M2 L3, 9, 11, 16–26 Level 4 M3 L3, 14, 19, 29–31 Level 4 M4 L2, 6, 13–17, 24–27 Level 5 M1 L2, 8, 12, 18–26 Level 5 M2 L2, 7, 14, 20–26 Level 5 M3 L3, 8, 13, 19–27 Level 5 M4 L2, 15, 17, 23–26

Making and Doing	Aligned PhD Science Lessons
Learns to use tools and materials to accomplish a task	Level 3 M1 L4–7, 21–26 Level 3 M4 L4, 23–27 Level 4 M1 L12–17 Level 4 M2 L12–14, 17–23 Level 4 M4 L14–17 Level 5 M1 L18–22 Level 5 M3 L19–23

Systems Thinking	Aligned PhD Science Lessons
Learns that human-designed things are connected	Level 3 M1 L4–7 Level 4 M1 L21–24 Level 4 M2 L1–3 Level 5 M4 L9–12

Creativity	Aligned PhD Science Lessons
Learns that humans create products and ways of doing things	Level 3 M1 L4–7 Level 4 M1 L21–24 Level 4 M2 L12–14, 17–23 Level 4 M4 L18–24 Level 5 M4 L9–12

Collaboration	Aligned PhD Science Lessons
Learns to share technological products and ideas	Level 3 M1 L4–7, 21–26 Level 3 M4 L23–27 Level 4 M1 L12–17 Level 4 M2 L12–14, 17–23 Level 5 M3 L19–23

Optimism	Aligned PhD Science Lessons
Sees opportunities for making technologies better	Level 3 M1 L21–26 Level 3 M2 L22–25 Level 3 M4 L23–27 Level 4 M1 L21–24 Level 4 M2 L17–23