

PhD Science[®] **K–5 Curriculum Correlation to the 2016 Massachusetts Science and Technology/Engineering (STE) Curriculum Framework**

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***PhD Science*[®] Correlation to the 2016 Massachusetts Science and Technology/Engineering (STE) Curriculum Framework: Level K**

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 Yellow indicates that *PhD Science* partially covers the standard within the grade level.



 Red indicates that *PhD Science* does not cover the standard.

Key: Module (M), Lesson (L)

The *PhD Science* Level K curriculum aligns with the Kindergarten Science and Technology/Engineering Learning Standards in the 2016 Massachusetts STE Curriculum Framework. A detailed analysis of alignment follows.

Kindergarten STE Disciplines and Standards

Earth and Space Science K-ESS

ESS2 Earth's Systems		Aligned <i>PhD Science</i> Lessons
K-ESS2-1	Use and share quantitative observations of local weather conditions to describe patterns over time.	 Level K M1 L1–11, 17–24, 28–30 Level K M4 L25
K-ESS2-2	Construct an argument supported by evidence for how plants and animals (including humans) can change the environment..	 Level K M4 L1–10, 14–16, 26–28

ESS3 Earth and Human Activity		Aligned <i>PhD Science</i> Lessons
K-ESS3-2	Obtain and use information about weather forecasting to prepare for, and respond to, different types of local weather.	Level K M1 L22–30
K-ESS3-3	Communicate solutions to reduce the amount of natural resources an individual uses.	Level K M4 L14–24, 26–28

Life Science K-LS

LS1 From Molecules to Organisms: Structures and Processes		Aligned <i>PhD Science</i> Lessons
K-LS1-1	Observe and communicate that animals (including humans) and plants need food, water, and air to survive. Animals get food from plants or other animals. Plants make their own food and need light to live and grow.	Level K M3 L4–16, 19–22, 27–29
K-LS1-2(MA)	Recognize that all plants and animals grow and change over time.	Level K M3 L4–16, 19–21, 27–29


Physical Science K-PS


PS1 Matter and Its Interactions		Aligned <i>PhD Science</i> Lessons
K-PS1-1(MA)	Investigate and communicate the idea that different kinds of materials can be solid or liquid depending on temperature.	Level 2 M1 L1–16, 19, 23, 29–31 Level 2 M2 L3–4, 14–17


PS2 Motion and Stability: Forces and Interactions		Aligned <i>PhD Science</i> Lessons
K-PS2-1	Compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.	Level K M2 L1–23


PS3 Energy		Aligned <i>PhD Science</i> Lessons
K-PS3-1	Make observations to determine that sunlight warms materials on Earth’s surface.	Level K M1 L8–11, 28–30
K-PS3-2	Use tools and materials to design and build a model of a structure that will reduce the warming effect of sunlight on an area.	Level K M1 L12–16, 28–30

***PhD Science*[®] Correlation to the 2016 Massachusetts Science and Technology/Engineering (STE) Curriculum Framework: Level 1**

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Key: Module (M), Lesson (L)

The *PhD Science* Level 1 curriculum aligns with the Grade 1 Science and Technology/Engineering Learning Standards in the *2016 Massachusetts Science and Technology/Engineering (STE) Curriculum Framework*. A detailed analysis of alignment follows.

Grade 1 STE Disciplines and Standards

Earth and Space Science 1-ESS

ESS1 Earth's Place in the Universe		Aligned <i>PhD Science</i> Lessons
1-ESS1-1	Use observations of the Sun, Moon, and stars to describe that each appears to rise in one part of the sky, appears to move across the sky, and appears to set.	 Level 1 M4 L1–8, 14–25
1-ESS1-2	Analyze provided data to identify relationships among seasonal patterns of change, including relative sunrise and sunset time changes, seasonal temperature and rainfall or snowfall patterns, and seasonal changes to the environment.	 Level 1 M4 L9–13, 23–25

Life Science 1-LS

LS1 From Molecules to Organisms: Structures and Processes		Aligned <i>PhD Science</i> Lessons
1-LS1-1	Use evidence to explain that (a) different animals use their body parts and senses 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, and (b) plants have roots, stems, leaves, flowers, and fruits that are used to take in water, air, and other nutrients and produce food for the plant.	Level 1 M1 L1–21, 27–29
1-LS1-2	Obtain information to compare ways in which the behavior of different animal parents and their offspring help the offspring to survive.	Level 1 M1 L24–29

LS3 Heredity: Inheritance and Variation of Traits		Aligned <i>PhD Science</i> Lessons
1-LS3-1	Use information from observations (firsthand and from media) to identify similarities and differences among individual plants or animals of the same kind.	Level 1 M1 L22–23, 26–29


Physical Science 1-PS


PS4 Waves and Their Applications in Technologies for Information Transfer		Aligned <i>PhD Science</i> Lessons
1-PS4-1	Demonstrate that vibrating materials can make sound and that sound can make materials vibrate.	Level 1 M3 L1–17, 26–29
1-PS4-3	Conduct an investigation to determine the effect of placing materials that allow light to pass through them, allow only some light through them, block all the light, or redirect light when put in the path of a beam of light.	Level 1 M2 L1–3, 10–23
1-PS4-4	Use tools and materials to design and build a device that uses light or sound to send a signal over a distance.	Level 1 M3 L18–29


Technology/Engineering 1-ETS

ETS1 Engineering Design		Aligned <i>PhD Science</i> Lessons
K-2-ETS1-1	Ask questions, make observations, and gather information about a situation people want to change that can be solved by developing or improving an object or tool.	Level 1 M1 L11–15
K-2-ETS1-2	Generate multiple solutions to a design problem and make a drawing (plan) to represent one or more of the solutions.	Level 1 M3 L21–25
K-2-ETS1-3	Analyze data from tests of two objects designed to solve the same design problem to compare the strengths and weaknesses of how each object performs.	Level 1 M3 L21–25

***PhD Science*® Correlation to the 2016 Massachusetts Science and Technology/Engineering (STE) Curriculum Framework: Level 2**

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The *PhD Science* Level 2 curriculum aligns with the Grade 2 Science and Technology/Engineering Learning Standards in the 2016 Massachusetts Science and Technology/Engineering (STE) Curriculum Framework. A detailed analysis of alignment follows.

Grade 2 STE Disciplines and Standards

Earth and Space Science 2-ESS

ESS2 Earth's Systems		Aligned <i>PhD Science</i> Lessons
2-ESS2-1	Investigate and compare the effectiveness of 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
2-ESS2-2	Map the shapes and types of landforms 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
2-ESS2-3	Use examples obtained from informational sources to explain that water is found in the oceans, rivers and streams, lakes and ponds, and may be solid or liquid.	Level 2 M4 L1–6, 16, 22–25
2-ESS2-4(MA)	Observe how blowing wind and flowing water can move Earth materials from one place to another and change the shape of a landform.	Level 2 M2 L1–17, 20, 22–24

Life Science 2-LS

LS2 Ecosystems: Interactions, Energy, and Dynamics		Aligned <i>PhD Science</i> Lessons
2-LS2-3(MA)	Develop and use models to compare how plants and animals depend on their surroundings and other living things to meet their needs in the places they live.	Level 2 M4 L1–3, 7–25

LS4. Biological Evolution: Unity and Diversity		Aligned <i>PhD Science</i> Lessons
2-LS4-1	Use texts, media, or local environments to observe and compare (a) different kinds of living things in an area and (b) differences in the kinds of living things living in different types of areas.	Level 2 M4 L1–3, 7–25

Physical Science 2-PS


PS1 Matter and Its Interactions		Aligned <i>PhD Science</i> Lessons
2-PS1-1	Describe and classify different kinds of materials by observable properties of color, flexibility, hardness, texture, and absorbency.	Level 2 M1 L1–9, 12–16, 19, 23, 29–31 Level 2 M2 L3–4, 14–17
2-PS1-2	Test different materials and analyze the data obtained to determine which materials have the properties that are best suited for an intended purpose.	Level 2 M1 L20–31
2-PS1-3	Analyze a variety of evidence to conclude that when a chunk of material is cut or broken into pieces, each piece is still the same material and, however small each piece is, has weight. Show that the material properties of a small set of pieces do not change when the pieces are used to build larger objects.	Level 2 M1 L10–11, 29–31
2-PS1-4	Construct an argument with evidence that some changes to materials caused by heating or cooling can be reversed and some cannot.	Level 2 M1 L14–19, 29–31


PS3 Energy		Aligned <i>PhD Science</i> Lessons
2-PS3-1(MA)	Design and conduct an experiment to show the effects of friction on the relative temperature and speed of objects that rub against each other.	Level 3 M4 L15–18 Level 5 M2 L16

Technology/Engineering 2-ETS

ETS1 Engineering Design		Aligned <i>PhD Science</i> Lessons
K-2-ETS1-1	Ask questions, make observations, and gather information about a situation people want to change that can be solved by developing or improving an object or tool.	Level 2 M1 L24–28 Level 2 M2 L8–12
K-2-ETS1-2	Generate multiple solutions to a design problem and make a drawing (plan) to represent one or more of the solutions.	Level 2 M3 L14–18
K-2-ETS1-3	Analyze data from tests of two objects designed to solve the same design problem to compare the strengths and weaknesses of how each object performs.	Level 2 M2 L8–12, 14–17

***PhD Science*® Correlation to the 2016 Massachusetts Science and Technology/Engineering (STE) Curriculum Framework: K–2 Disciplinary Core Ideas, Science and Engineering Practices, Crosscutting Concepts, and Understandings About the Nature of Science**

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The *PhD Science* K–2 curriculum aligns with the K–2 Disciplinary Core Ideas, Science and Engineering Practices, Crosscutting Concepts, and Understandings About the Nature of Science in the 2016 Massachusetts STE Curriculum Framework. A detailed analysis of alignment follows.

Disciplinary Core Ideas K–2

Earth and Space Science

ESS1.A The Universe and Its Stars ESS1.B Earth and the Solar System	Aligned <i>PhD Science</i> Lessons
Patterns of movement of the Sun, Moon, and stars as seen from Earth can be observed, described, and predicted.	 Level 1 M4 L1–25

ESS2.A Earth Materials and Systems	Aligned <i>PhD Science</i> Lessons
Wind and water change the shape of the land.	Level 2 M2 L1–17, 20, 22–24
ESS2.B Plate Tectonics and Large-Scale System Interactions	Aligned <i>PhD Science</i> 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 <i>PhD Science</i> Lessons
Water is found in many types of places and in different forms on Earth.	Level 2 M4 L1–6, 16, 22–25
ESS2.D Weather and Climate	Aligned <i>PhD Science</i> Lessons
Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region and time. People record weather patterns over time.	Level K M1 L1–11, 17–24, 28–30 Level K M4 L25
ESS3.A Natural Resources	Aligned <i>PhD Science</i> 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 <i>PhD Science</i> Lessons
In a region, some kinds of severe weather are more likely than others. Forecasts allow communities to prepare for severe weather.	Level K M1 L17–20, 22–30
ESS3.C Human Impacts on Earth Systems	Aligned <i>PhD Science</i> Lessons
Things people do can affect the environment but they can make choices to reduce their impacts.	Level K M4 L11–24, 26–28

Life Science

LS1.A Structure and Function		Aligned <i>PhD Science</i> Lessons
Plants and animals have external parts that they use to perform daily functions.		Level 1 M1 L1–15, 27–29
LS1.B Growth and Development of Organisms		Aligned <i>PhD Science</i> Lessons
Parents and offspring engage in behaviors that help offspring survive. Plants and animals have a life cycle.		Level 1 M1 L24–29
LS1.C Organization for Matter and Energy Flow in Organisms		Aligned <i>PhD Science</i> Lessons
Animals obtain food they need from plants or other animals. Plants need air, water, and light. Plants do not eat food; instead, they make their own “food.”		Level K M3 L4–16, 19–20, 22, 27–29
LS2.A Interdependent Relationships in Ecosystems		Aligned <i>PhD Science</i> Lessons
Plants and animals depend on their surroundings to get what they need.		Level 2 M3 L1–29
LS3.A Inheritance of Traits LS3.B Variation of Traits		Aligned <i>PhD Science</i> Lessons
Young organisms are very much, but not exactly, like their parents and also resemble other organisms of the same kind.		Level 1 M1 L22–23, 26–29
LS4.C Adaptation		Aligned <i>PhD Science</i> Lessons
Different places on Earth each have their own unique assortment of organisms.		Level 2 M4 L1–3, 7–25

Physical Science

PS1.A Structure of Matter	Aligned <i>PhD Science</i> Lessons
Matter exists as different substances that have observable different 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
Matter can be divided into smaller pieces, even if it can't be seen.	Level 2 M1 L10–11
Objects can be built up from smaller parts.	Level 2 M1 L10–11, 24–31
PS1.B Chemical Reactions	Aligned <i>PhD Science</i> Lessons
Heating and cooling substances cause changes that are sometimes reversible and sometimes not.	Level 2 M1 L14–19, 29–31
PS2.A Forces and Motion PS2.B Types of Interactions	Aligned <i>PhD Science</i> Lessons
Pushes and pulls can have different strengths and directions, and can change the speed or direction of an object's motion or start or stop it. Bigger pushes and pulls cause bigger changes in an object's motion.	Level K M2 L1–23
PS3.D Energy in Chemical Processes and Everyday Life	Aligned <i>PhD Science</i> Lessons
Sunlight warms Earth's surface.	Level K M1 L8–16, 28–30
Friction warms objects that rub against each other.	Level 5 M2 L16
PS4.A Wave Properties	Aligned <i>PhD Science</i> Lessons
Sound can make matter vibrate and vibrating matter can make sound.	Level 1 M3 L1–17, 26–29
PS4.B Electromagnetic Radiation	Aligned <i>PhD Science</i> Lessons
Some materials allow light to pass through, block light (creating shadows), or redirect light.	Level 1 M2 L1–3, 10–23
PS4.C Information Technologies and Instrumentation	Aligned <i>PhD Science</i> Lessons
People use devices to send and receive information.	Level 1 M3 L18–29

Technology/Engineering

ETS1.A Define Design Problems	Aligned <i>PhD Science</i> Lessons
Situations that people want to change can be solved through engineering.	Level K M1 L4–7, 12–16 Level K M2 L17–20 Level 1 M1 L11–15 Level 2 M1 L24–28 Level 2 M2 L8–12
ETS1.B Develop Solutions	Aligned <i>PhD Science</i> Lessons
Solutions can be conveyed through visual or physical representations.	Level K M2 L17–20 Level K M4 L20–24 Level 1 M3 L21–25 Level 2 M3 L14–18
ETS1.C Optimize Solutions	Aligned <i>PhD Science</i> Lessons
Solutions are compared, tested, and evaluated.	Level K M4 L20–24 Level 1 M3 L21–25 Level 2 M2 L8–12, 14–17

Science and Engineering Practices: K-2

1. Asking Questions and Defining Problems	Aligned <i>PhD Science</i> Lessons
Ask questions based on observations to find more information about the natural and/or designed worlds.	Level K M1 L1-3, 22-26 Level K M2 L1-3, 9 Level K M3 L1-3, 14-16, 27-29 Level 1 M1 L1-3 Level 1 M2 L1-3 Level 1 M3 L1-3 Level 1 M4 L1-3, 14-16 Level 2 M1 L1-3 Level 2 M2 L1-2 Level 2 M3 L1-2 Level 2 M4 L1-3
Ask and/or identify questions that can be answered by an investigation.	Level K M1 L8-9 Level K M3 L4-8, 22 Level 2 M3 L3-6
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 Level 1 M1 L11-15 Level 2 M3 L14-18

2. Developing and Using Models	Aligned <i>PhD Science</i> Lessons
Distinguish between a model and the actual object, process, and/or events the model represents.	Level K M1 L1–2, 12–16 Level K M2 L1–3, 10–12 Level 1 M1 L4–9, 18 Level 1 M3 L14 Level 2 M4 L4–6
Compare models to identify common features and differences.	Level 1 M1 L11–15 Level 1 M2 L1–3 Level 2 M4 L1–6, 20–21, 23–25
Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed worlds.	Level K M3 L1–3, 9–12, 19–20 Level K M4 L1–9, 11–16 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 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 K M1 L12–16 Level 1 M1 L11–15 Level 2 M3 L14–18

3. Planning and Carrying Out Investigations	Aligned <i>PhD Science</i> Lessons
With guidance, plan and conduct an investigation in collaboration with peers.	Level K M2 L7–8, 10–15 Level K M3 L4–8
Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.	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
Evaluate different ways of observing and/or measuring a phenomenon to determine which way to answer a question.	Level K M4 L3–5 Level 2 M2 L3–4, 8–12, 22–24
Make observations (firsthand or from media) and/or measurements 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 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 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
Make observations (firsthand or from media) and/or measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal.	Level K M1 L4–7, 12–20 Level K M2 L17–20 Level 1 M3 L8–9, 20–25 Level 2 M1 L20–22, 24–28 Level 2 M2 L14–17
Make predictions based on prior experiences.	Level K M2 L13–15 Level K M3 L4–8 Level 1 M3 L11–13, 15–17, 26–29 Level 1 M4 L1–3 Level 2 M1 L17–18

4. Analyzing and Interpreting Data	Aligned <i>PhD Science</i> Lessons
Record information (observations, thoughts, and ideas).	Level K M1 L4–7, 22–24 Level K M2 L4–6, 21–23 Level K M3 L1–3, 9–16 Level K M4 L14–16 Level 1 M1 L10 Level 2 M1 L4–7, 10–11, 14–18
Use and share pictures, drawings, and/or writings of observations.	Level K M2 L7–8 Level K M4 L1–2, 6–7, 10, 14–17, 20–24, 26–28
Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed worlds in order to answer scientific questions and solve problems.	Level K M3 L4–8, 14–20, 22–26 Level K M4 L25 Level 1 M1 L16–21, 27–29 Level 1 M2 L1–9 Level 1 M3 L10 Level 1 M4 L4–6, 9–13 Level 2 M1 L4–11 Level 2 M2 L5–6, 8–9 Level 2 M3 L19–20 Level 2 M4 L22–25
Compare predictions (based on prior experiences) to what occurred (observable events).	Level K M4 L14–16 Level 1 M3 L11–13, 15–16, 26–29
Analyze data from tests of an object or tool to determine if it works as intended.	Level K M4 L20–24 Level 1 M3 L8–9 Level 2 M1 L20–22, 24–28 Level 2 M3 L14–18

5. Using Mathematics and Computational Thinking	Aligned <i>PhD Science</i> Lessons
Decide when to use qualitative versus quantitative data.	Level K M2 L17–20 Level 1 M2 L15–18
Use counting and numbers to identify and describe patterns in the natural and designed worlds.	Level K M1 L17–21, 25–30 Level K M2 L17–20 Level 2 M4 L7–8, 20–22
Describe, measure, and/or compare quantitative attributes of different objects and display the data using simple graphs.	Level 2 M1 L20–22 Level 2 M3 L8–11, 23–29 Level 2 M4 L17–19
Use quantitative data to compare two alternative solutions to a problem	Level 1 M3 L21–25 Level 2 M2 L14–17

6. Constructing Explanations and Designing Solutions	Aligned <i>PhD Science</i> Lessons
Use information from observations (firsthand and from media) to construct an evidence-based account for natural phenomena.	Level K M3 L4–16, 23–29 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 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.	Level K M2 L17–20 Level 1 M1 L11–15 Level 2 M1 L24–28
Generate and/or compare multiple solutions to a problem.	Level 1 M3 L21–25 Level 2 M2 L8–12, 14–17

7. Engaging in Argument from Evidence	Aligned <i>PhD Science</i> Lessons
Identify arguments that are supported by evidence.	Level K M3 L17–18 Level 1 M4 L4–8, 23–25
Distinguish between explanations that account for all gathered evidence and those that do not.	Level 1 M3 L4–6 Level 1 M4 14–18
Analyze why some evidence is relevant to a scientific question and some is not.	Level K M4 L25 Level 1 M4 L19–25 Level 2 M4 L20–21
Distinguish between opinions and evidence in one’s own explanations.	Level K M3 L17–18 Level 1 M4 L9–13
Listen actively to arguments to indicate agreement or disagreement based on evidence and/or to retell the main points of the argument.	Level K M3 L17–20 Level K M4 L3–5, 11–13 Level 2 M2 L20 Level 2 M4 L4–6, 9–13, 23–25
Construct an argument with evidence to support a claim.	Level K M3 L17–21, 27–29 Level 1 M4 L9–13, 19–21 Level 2 M2 L3–4, 10–13, 21–24 Level 2 M4 L16
Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence.	Level 1 M3 L8–9, 18–20 Level 2 M3 L14–18, 21–22

8. Obtaining, Evaluating, and Communicating Information	Aligned <i>PhD Science</i> Lessons
Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed worlds.	Level K M4 L1–2, 6–10, 14–16, 18–19 Level 1 M1 L24–25 Level 1 M3 L18–19 Level 1 M4 L9–13 Level 2 M2 L1–2, 14–17
Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea.	Level 1 M4 L14–18, 23–25 Level 2 M3 L14–18
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 and/or supporting a scientific claim.	Level K M3 L23–26 Level 2 M2 L5–6, 18–19 Level 2 M4 L4–9, 11–16, 23–25
Communicate information or design ideas and/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 Level 1 M1 L27–29 Level 1 M2 L21–23 Level 1 M3 L26–29 Level 1 M4 L23–25 Level 2 M1 L29–31 Level 2 M2 L22–24 Level 2 M3 L8–12, 14–20, 25–29 Level 2 M4 L23–25

Crosscutting Concepts: K–2

1. Patterns	Aligned <i>PhD Science</i> Lessons
<p>Students can recognize that patterns in the natural and human-designed world can be observed, used to describe phenomena, and used as evidence.</p>	<p>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 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 Level 2 M1 L4–9 Level 2 M2 L1–2, 5–6 Level 2 M4 L1–8, 11–15, 20–21, 23–25</p>
2. Cause and Effect: Mechanism and Explanation	Aligned <i>PhD Science</i> Lessons
<p>Students can learn that events have causes that generate observable patterns. They design simple tests to gather evidence to support or refute their own ideas about causes.</p>	<p>Level K M2 L4–16, 17–23 Level K M4 L3–5, 10, 14–19, 26–28 Level 1 M3 L4–6, 14, 17, 26–29 Level 1 M4 L4–6, 9–13, 17–21, 23–25 Level 2 M1 L14–19, 29–31 Level 2 M2 L20–21 Level 2 M3 L8–11</p>
3. Scale, Proportion, and Quantity	Aligned <i>PhD Science</i> Lessons
<p>Students can use relative scales (e.g., bigger and smaller, hotter and colder, faster and slower) to describe objects. They use standard units to measure length.</p>	<p>Level K M1 L1–7, 10–24, 28–30 Level K M2 L7–9, 13–15, 21–23 Level K M3 L1–3 Level K M4 L25 Level 2 M1 L8–9 Level 2 M2 L18–21 Level 2 M3 L25–29 Level 2 M4 L1–6, 17–19, 22–25</p>

<p>4. Systems and System Models</p>	<p>Aligned <i>PhD Science</i> Lessons</p>
<p>Students can understand that objects and organisms can be described in terms of their parts and that systems in the natural and designed world have parts that work together.</p>	<p>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, 10–23 Level 1 M3 L21–25 Level 2 M1 L1–7, 12–13, 20–23, 29–31 Level 2 M2 L3–4, 7–12, 14–17 Level 2 M3 L8–13, 19–24 Level 2 M4 L7–16, 23–25</p>
<p>5. Energy and Matter: Flows, Cycles, and Conservation</p>	<p>Aligned <i>PhD Science</i> Lessons</p>
<p>Students can observe that objects may break into smaller pieces, be put together into larger pieces, or change shapes.</p>	<p>Level 2 M1 L10–11, 29–31 Level 2 M2 L3–4, 8–13, 22–24</p>
<p>6. Structure and Function</p>	<p>Aligned <i>PhD Science</i> Lessons</p>
<p>Students can observe that the shapes and stability of structures of natural and designed objects are related to their functions.</p>	<p>Level K M1 L10–16 Level K M4 L20–24 Level 1 M1 L4–15, 27–29 Level 1 M3 L8–9 Level 2 M1 L24–28 Level 2 M2 L14–17 Level 2 M3 L8–11, 14–22</p>
<p>7. Stability and Change</p>	<p>Aligned <i>PhD Science</i> Lessons</p>
<p>Students can observe that some things stay the same while other things change, and things may change slowly or rapidly.</p>	<p>Level K M1 L8–9, 17–21 Level K M4 L14–16 Level 2 M2 L1–2, 22–24 Level 2 M3 L1–2, 25–29</p>

8. Interdependence of Science, Engineering, and Technology	Aligned <i>PhD Science</i> Lessons
Students can understand that science and engineering involve the use of tools to observe and measure things.	Level 2 M3 L3–6, 14–18

9. Influence of Engineering, Technology, and Science on Society and the Natural World	Aligned <i>PhD Science</i> Lessons
Students can understand that every human-made product is designed by applying some knowledge of the natural world and is built by using natural materials. Taking natural materials to make things also makes an impact on the environment.	Level K M4 L1–4, 11–13, 17 Level 1 M1 L10–15 Level 2 M2 L14–17 Level 2 M3 L14–18

Understandings About the Nature of Science (Practices): K–2

Scientific Investigations Use a Variety of Methods	Aligned <i>PhD Science</i> Lessons
Science investigations begin with a question.	Level K M1 L8–9 Level K M4 L20–24 Level 1 M2 L15–18
Scientists use different ways to study the world.	Level K M2 L16 Level 1 M4 L4–6

Scientific Knowledge Is Based on Empirical Evidence	Aligned <i>PhD Science</i> Lessons
Scientists look for patterns and order when making observations about the world.	Level K M3 L4–8, 14–16 Level 1 M1 L24–25 Level 1 M2 L10–12 Level 2 M4 L11–13, 17–21

Scientific Knowledge Is Open to Revision in Light of New Evidence	Aligned <i>PhD Science</i> Lessons
Science knowledge can change when new information is found.	Level 1 M3 L15–16 Level 2 M4 L4–6


Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena	Aligned <i>PhD Science</i> Lessons
Scientists use drawings, sketches, and models as a way to communicate ideas.	Level K M4 L1–2 Level 1 M4 L7–8 Level 2 M4 L14–17
Scientists search for cause and effect relationships to explain natural events.	Level 1 M2 L10–12 Level 2 M2 L10–12


Science Is a Way of Knowing	Aligned <i>PhD Science</i> Lessons
Science knowledge helps us know about the world.	Level K M2 L4–6, 9 Level K M4 L25
Scientific Knowledge Assumes an Order and Consistency in Natural Systems	Aligned <i>PhD Science</i> Lessons
Science assumes natural events happen today as they happened in the past.	Level K M1 L21 Level 1 M4 L9–13 Level 2 M2 L20–21
Many events are repeated.	Level K M1 L17–20 Level 1 M4 L9–13


Science Is a Human Endeavor	Aligned <i>PhD Science</i> Lessons
People have practiced science for a long time.	Level K M3 L14–16 Level 1 M4 L7–8
Men and women of diverse backgrounds are scientists and engineers.	Level K M3 L14–16

Science Addresses Questions About the Natural and Material World	Aligned <i>PhD Science</i> Lessons
<p>Scientists study the natural and material world.</p>	<p>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 L27–29 Level 1 M2 L21–23 Level 1 M3 L26–29 Level 1 M4 L23–25 Level 2 M1 L20–22, 29–31 Level 2 M2 L1–4, 22–24 Level 2 M3 L25–29 Level 2 M4 L23–25</p>

PhD Science® Correlation to the 2016 Massachusetts Science and Technology/Engineering (STE) Curriculum Framework: Level 3

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Key: Module (M), Lesson (L)

The *PhD Science* Level 3 curriculum aligns with the Grade 3 Science and Technology/Engineering Learning Standards in the *2016 Massachusetts STE Curriculum Framework*. A detailed analysis of alignment follows.

Grade 3 STE Disciplines and Standards

Earth and Space Science 3-ESS

ESS2 Earth's Systems		Aligned <i>PhD Science</i> Lessons
3-ESS2-1	Use graphs and tables of local weather data to describe and predict typical weather during a particular season in an area.	Level 3 M1 L1–15, 19–20, 27–29
3-ESS2-2	Obtain and summarize information about the climate of different regions of the world to illustrate that typical weather conditions over a year vary by region.	Level 3 M1 L11–15, 27–29

ESS3 Earth and Human Activity		Aligned <i>PhD Science</i> Lessons
3-ESS3-1	Evaluate the merit of a design solution that reduces the damage caused by weather.	Level 3 M1 L1–3, 16–29

Life Science 3-LS

LS1 From Molecules to Organisms: Structures and Processes		Aligned <i>PhD Science</i> Lessons
3-LS1-1	Use simple graphical representations to show that different types of organisms have unique and diverse life cycles. Describe that all organisms have birth, growth, reproduction, and death in common but there are a variety of ways in which these happen.	Level 3 M3 L7–8, 23–28

LS3 Heredity: Inheritance and Variation of Traits		Aligned <i>PhD Science</i> Lessons
3-LS3-1	Provide evidence, including through the analysis of data, that plants and animals have traits inherited from parents and that variation of these traits exist in a group of similar organisms.	Level 3 M3 L1–6, 14–18, 26–28
3-LS3-2	Distinguish between inherited characteristics and those characteristics that result from a direct interaction with the environment. Give examples of characteristics of living organisms that are influenced by both inheritance and the environment.	Level 3 M3 L9–15, 19–20, 26–28

LS4 Biological Evolution: Unity and Diversity		Aligned <i>PhD Science</i> Lessons
3-LS4-1	Use fossils to describe types of organisms and their environments that existed long ago and compare those to living organisms and their environments. Recognize that most kinds of plants and animals that once lived on Earth are no longer found anywhere.	Level 3 M2 L1–8, 26–28
3-LS4-2	Use evidence to construct an explanation for how the variations in characteristics among individuals within the same species may provide advantages to these individuals in their survival and reproduction.	Level 3 M3 L21–28
3-LS4-3	Construct an argument with evidence that in a particular environment some organisms can survive well, some survive less well, and some cannot survive.	Level 3 M2 L1–2, 9–12, 16–19, 22–28
3-LS4-4	Analyze and interpret given data about changes in a habitat and describe how the changes may affect the ability of organisms that live in that habitat to survive and reproduce.	Level 3 M2 L16–28
3-LS4-5(MA)	Provide evidence to support a claim that the survival of a population is dependent upon reproduction.	Level 3 M3 L23–25


Physical Science 3-PS


PS2 Motion and Stability: Forces and Interactions		Aligned <i>PhD Science</i> Lessons
3-PS2-1	Provide evidence to explain the effect of multiple forces, including friction, on an object. Include balanced forces that do not change the motion of the object and unbalanced forces that do change the motion of the object.	Level 3 M4 L10–18, 28–30
3-PS2-3	Conduct an investigation to determine the nature of the forces between two magnets based on their orientations and distance relative to each other.	Level 3 M4 L19–21, 28–30
3-PS2-4	Define a simple design problem that can be solved by using interactions between magnets.	Level 3 M4 L22–30


Technology/Engineering 3-ETS


ETS1 Engineering Design		Aligned <i>PhD Science</i> Lessons
3.3–5-ETS1-1	Define a simple design problem that reflects a need or a want. Include criteria for success and constraints on materials, time, or cost that a potential solution must meet.	Level 3 M1 L21–26
3.3–5-ETS1-2	Generate several possible solutions to a given design problem. Compare each solution based on how well each is likely to meet the criteria and constraints of the design problem.	Level 3 M2 L22–25
3.3–5-ETS1-4(MA)	Gather information using various informational resources on possible solutions to a design problem. Present different representations of a design solution.	Level 3 M1 L21–26 Level 3 M4 L23–27

***PhD Science*[®] Correlation to the 2016 Massachusetts Science and Technology/Engineering (STE) Curriculum Framework: Level 4**

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Key: Module (M), Lesson (L)

The *PhD Science* Level 4 curriculum aligns with the Grade 4 Science and Technology/Engineering Learning Standards in the *2016 Massachusetts STE Curriculum Framework*. A detailed analysis of alignment follows.

Grade 4 STE Disciplines and Standards

Earth and Space Science 4-ESS

ESS1 Earth's Place in the Universe		Aligned <i>PhD Science</i> Lessons
4-ESS1-1	Use evidence from a given landscape that includes simple landforms and rock layers to support a claim about the role of erosion or deposition in the formation of the landscape over long periods of time.	Level 4 M1 L1–5, 8–11, 19–20, 25–27

ESS2 Earth's Systems		Aligned <i>PhD Science</i> Lessons
4-ESS2-1	Make observations and collect data to provide evidence that rocks, soils, and sediments are broken into smaller pieces through mechanical weathering and moved around through erosion.	Level 4 M1 L6–11, 25–27
4-ESS2-2	Analyze and interpret maps of Earth's mountain ranges, deep ocean trenches, volcanoes, and earthquake epicenters to describe patterns of these features and their locations relative to boundaries between continents and oceans.	Level 4 M1 L18–20, 25–27

ESS3 Earth and Human Activity		Aligned <i>PhD Science</i> Lessons
4-ESS3-1	Obtain information to describe that energy and fuels humans use are derived from natural resources and that some energy and fuel sources are renewable and some are not.	Level 4 M1 L21–27
4-ESS3-2	Evaluate different solutions to reduce the impacts of a natural event such as an earthquake, blizzard, or flood on humans.	Level 4 M1 L12–17, 25–27

Life Science 4-LS

LS1 From Molecules to Organisms: Structures and Processes		Aligned <i>PhD Science</i> Lessons
4-LS1-1	Construct an argument that animals and plants have internal and external structures that support their survival, growth, behavior, and reproduction.	Level 4 M3 L1–6, 20, 26–31

Physical Science 4-PS


PS3 Energy		Aligned <i>PhD Science</i> Lessons
4-PS3-1	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
4-PS3-2	Make observations to show 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
4-PS3-3	Ask questions and predict outcomes about the changes in energy that occur when objects collide.	Level 4 M2 L8–9, 24–26
4-PS3-4	Apply scientific principles of energy and motion to test and refine a device that converts kinetic energy to electrical energy or uses stored energy to cause motion or produce light or sound.	Level 4 M2 L12–26


PS4 Waves and Their Applications in Technologies for Information Transfer		Aligned <i>PhD Science</i> Lessons
4-PS4-1	Develop a model of a simple mechanical wave (including sound) to communicate that waves (a) are regular patterns of motion along which energy travels and (b) can cause objects to move.	Level 4 M3 L7–14, 29–31
4-PS4-2	Develop a model to describe that light must reflect off an object and enter the eye for the object to be seen.	Level 4 M4 L1–17, 25–27
4-PS4-3	Develop and compare multiple ways to transfer information through encoding, sending, receiving, and decoding a pattern.	Level 4 M4 L18–27

Technology/Engineering 4-ETS

ETS1 Engineering Design		Aligned <i>PhD Science</i> Lessons
4.3–5-ETS1-3	Plan and carry out tests of one or more design features of a given model or prototype in which variables are controlled and failure points are considered to identify which features need to be improved. Apply the results of tests to redesign a model or prototype.	Level 4 M4 L14–17
4.3–5-ETS1-5(MA)	Evaluate relevant design features that must be considered in building a model or prototype of a solution to a given design problem.	Level 4 M4 L14–17

***PhD Science*® Correlation to the 2016 Massachusetts Science and Technology/Engineering (STE) Curriculum Framework: Level 5**

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Key: Module (M), Lesson (L)

The *PhD Science* Level 5 curriculum aligns with the Grade 5 Science and Technology/Engineering Learning Standards in the 2016 Massachusetts STE Curriculum Framework. A detailed analysis of alignment follows.

Grade 5 STE Disciplines and Standards

Earth and Space Science 5-ESS

ESS1 Earth's Place in the Universe		Aligned <i>PhD Science</i> Lessons
5-ESS1-1	Use observations, firsthand and from various media, to argue that the Sun is a star that appears larger and brighter than other stars because it is closer to Earth.	Level 5 M4 L18–19, 24–26
5-ESS1-2	Use a model to communicate Earth's relationship to the Sun, Moon, and other stars that explain[s] (a) why people on Earth experience day and night, (b) patterns in daily changes in length and direction of shadows over a day, and (c) changes in the apparent position of the Sun, Moon, and stars at different times during a day, over a month, and over a year.	Level 5 M4 L1–2, 5–17, 20–26

ESS2 Earth's Systems		Aligned <i>PhD Science</i> Lessons
5-ESS2-1	Use a model to describe the cycling of water through a watershed through evaporation, precipitation, absorption, surface runoff, and condensation.	Level 5 M3 L1–3, 6–13, 19–27
5-ESS2-2	Describe and graph the relative amounts of salt water in the ocean; fresh water in lakes, rivers, and groundwater; and fresh water frozen in glaciers and polar ice caps to provide evidence about the availability of fresh water in Earth's biosphere.	Level 5 M3 L4–5, 19–27

ESS3 Earth and Human Activity		Aligned <i>PhD Science</i> Lessons
5-ESS3-1	Obtain and combine information about ways communities reduce human impact on the Earth's resources and environment by changing an agricultural, industrial, or community practice or process.	Level 5 M3 L14–18, 24–27
5-ESS3-2(MA)	Test a simple system designed to filter particulates out of water and propose one change to the design to improve it.	<i>PhD Science</i> does not cover this topic.

Life Science 5-LS

LS1 From Molecules to Organisms: Structures and Processes		Aligned <i>PhD Science</i> Lessons
5-LS1-1	Ask testable questions about the process by which plants use air, water, and energy from sunlight to produce sugars and plant materials needed for growth and reproduction.	Level 5 M2 L3–5, 24–26

LS2 Ecosystems: Interactions, Energy, and Dynamics		Aligned <i>PhD Science</i> Lessons
5-LS2-1	Develop a model to describe the movement of matter among producers, consumers, decomposers, and the air, water, and soil in the environment to (a) show that plants produce sugars and plant materials, (b) show that animals can eat plants and/or other animals for food, and (c) show that some organisms, including fungi and bacteria, break down dead organisms and recycle some materials back to the air and soil.	Level 5 M2 L1–2, 6–14, 20, 24–26
5-LS2-2(MA)	Compare at least two designs for a compost to determine which is most likely to encourage decomposition of materials.	<i>PhD Science</i> does not cover this topic.


Physical Science 5-PS


PS1 Matter and Its Interactions		Aligned <i>PhD Science</i> Lessons
5-PS1-1	Use a particle model of matter to explain common phenomena involving gases, and phase changes between gas and liquid and between liquid and solid.	Level 5 M1 L5–10, 23–26
5-PS1-2	Measure and graph the weights (masses) of substances before and after a reaction or phase change to provide evidence that regardless of the type of change that occurs when heating, cooling, or combining substances, the total weight (mass) of matter is conserved.	Level 5 M1 L9–17, 23–26
5-PS1-3	Make observations and measurements of substances to describe characteristic properties of each, including color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility.	Level 5 M1 L1–4, 11–17, 23–26
5-PS1-4	Conduct an experiment to determine whether the mixing of two or more substances results in new substances with new properties (a chemical reaction) or not (a mixture).	Level 5 M1 L1–2, 13–26
PS2 Motion and Stability: Forces and Interactions		Aligned <i>PhD Science</i> Lessons
5-PS2-1	Support an argument with evidence that the gravitational force exerted by Earth on objects is directed toward Earth’s center.	Level 5 M4 L3–4, 24–26
PS3 Energy		
5-PS3-1	Use a model to describe that the food animals digest (a) contains energy that was once energy from the Sun, and (b) provides energy and nutrients for life processes, including body repair, growth, motion, body warmth, and reproduction.	Level 5 M2 L15–19, 24–26

Technology/Engineering 5-ETS

ETS3 Technological Systems		Aligned <i>PhD Science</i> Lessons
5.3–5-ETS3-1(MA)	Use informational text to provide examples of improvements to existing technologies (innovations) and the development of new technologies (inventions). Recognize that technology is any modification of the natural or designed world done to fulfill human needs or wants.	Level 5 M3 L19–23
5.3–5-ETS3-2(MA)	Use sketches or drawings to show how each part of a product or device relates to other parts in the product or device.	Level 5 M4 L9–12

***PhD Science®* Correlation to the 2016 Massachusetts Science and Technology/Engineering (STE) Curriculum Framework: 3–5 Disciplinary Core Ideas, Science and Engineering Practices, Crosscutting Concepts, and Understandings About the Nature of Science**

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Key: Module (M), Lesson (L)

The *PhD Science* 3–5 curriculum aligns with the 3–5 Disciplinary Core Ideas, Science and Engineering Practices, Crosscutting Concepts, and Understandings About the Nature of Science in the 2016 Massachusetts STE Curriculum Framework. A detailed analysis of alignment follows.

Disciplinary Core Ideas 3–5

Earth and Space Science

ESS1.A The Universe and Its Stars	Aligned <i>PhD Science</i> Lessons
Stars range greatly in their distance from Earth and this can explain their relative brightness.	 Level 5 M4 L18–19, 24–26
ESS1.B Earth and the Solar System	Aligned <i>PhD Science</i> Lessons
The Earth’s orbit and rotation, and the orbit of the Moon around the Earth, cause observable patterns.	 Level 5 M4 L1–2, 5–17, 20–26
ESS1.C The History of Planet Earth	Aligned <i>PhD Science</i> Lessons
Patterns in rock formations and fossils indicate changes in landscapes over time.	 Level 4 M1 L1–5, 19–20, 25–27

ESS2.A Earth Materials and Systems	Aligned <i>PhD Science</i> Lessons
The water cycle involves interactions of the four major Earth systems. Water, ice, wind, and organisms break rocks, soils, and sediments into smaller pieces and move them around.	Level 5 M3 L1–13, 24–27
ESS2.B Plate Tectonics and Large-Scale System Interactions	Aligned <i>PhD Science</i> Lessons
Earth’s physical features occur in patterns, as do earthquakes and volcanoes. Maps can be used to locate features and determine patterns in those events.	Level 4 M1 L18–20, 25–27
ESS2.C The Roles of Water in Earth’s Surface Processes	Aligned <i>PhD Science</i> Lessons
Most of Earth’s water is in the ocean and much of the Earth’s fresh water is in glaciers or underground.	Level 5 M3 L4–5, 24–27
ESS2.D Weather and Climate	Aligned <i>PhD Science</i> Lessons
Climate describes patterns of typical weather conditions over different scales and variations. Historical weather patterns can be analyzed.	Level 3 M1 L11–15, 27–29
ESS3.A Natural Resources	Aligned <i>PhD Science</i> Lessons
Energy and fuels humans use are derived from natural sources and their use affects the environment. Some resources are renewable over time; others are not.	Level 4 M1 L21–27
ESS3.B Natural Hazards	Aligned <i>PhD Science</i> Lessons
A variety of hazards result from natural processes; humans cannot eliminate hazards but can reduce their impacts.	Level 3 M1 L1–3, 16–29 Level 4 M1 L12–17, 25–27
ESS3.C Human Impacts on Earth Systems	Aligned <i>PhD Science</i> Lessons
Societal activities can help protect Earth’s resources and environments.	Level 5 M3 L14–27

Life Science

LS1.A Structure and Function	Aligned <i>PhD Science</i> Lessons
Organisms have both internal and external macroscopic structures that enable growth, survival, behavior, and reproduction.	Level 4 M3 L1–6, 20, 26–31
LS1.B Growth and Development of Organisms	Aligned <i>PhD Science</i> Lessons
Reproduction is essential to every kind of organism. Organisms have unique and diverse life cycles, cycles, including birth/sprouting, growth, and death.	Level 3 M3 L7–8, 23–28
LS1.C Organization for Matter and Energy Flow in Organisms	Aligned <i>PhD Science</i> Lessons
Food provides animals with the materials and energy they need for body repair, growth, warmth, and motion. Plants acquire material for growth chiefly from air and water, and obtain energy from sunlight, which is used to maintain conditions necessary for survival.	Level 5 M2 L3–5, 8–9, 15–19, 24–26
LS2.A Interdependent Relationships in Ecosystems	Aligned <i>PhD Science</i> Lessons
Some animals eat plants for food and other animals eat the animals that eat plants, while decomposers restore some materials back to the soil. These relationships among organisms in an ecosystem are represented by food webs.	Level 5 M2 L1–2, 8–14, 20, 24–26
LS2.B Cycles of Matter and Energy Transfer in Ecosystems	Aligned <i>PhD Science</i> Lessons
Matter cycles between the air, water, and soil and among organisms as they live and die.	Level 5 M2 L6–7, 10–14, 24–26
LS2.C Ecosystem Dynamics, Functioning, and Resilience	Aligned <i>PhD Science</i> Lessons
When the environment changes some organisms survive and reproduce, some move to new locations, some new organisms move into the transformed environment, and some die.	Level 3 M2 L16–28
LS3.A Inheritance of Traits LS3.B Variation of Traits	Aligned <i>PhD Science</i> Lessons
Different organisms vary in how they look and function because they have different inherited information; the environment also affects the traits that an organism develops. Variations of a trait exist in a group of similar organisms.	Level 3 M3 L1–6, 9–20, 23–28

LS4.A Evidence of Common Ancestry and Diversity	Aligned <i>PhD Science</i> Lessons
Fossils provide evidence about the types of organisms that existed long ago. Some living organisms resemble organisms that once lived on Earth.	Level 3 M2 L1–8, 26–28
LS4.B Natural Selection	Aligned <i>PhD Science</i> Lessons
Differences in characteristics between individuals of the same species can provide advantages in surviving and reproducing.	Level 3 M3 L21–28
LS4.C Adaptation	Aligned <i>PhD Science</i> Lessons
Particular organisms can only survive in particular environments. In any environment, some kinds of organisms, and some individuals of a given species, survive better than others.	Level 3 M2 L1–2, 9–12, 16–19, 22–28

Physical Science

PS1.A Structure of Matter	Aligned <i>PhD Science</i> Lessons
Because matter exists as particles that are too small to see, matter is always conserved even if it seems to disappear. Measurements of a variety of observable properties can be used to identify particular materials.	Level 5 M1 L1–17, 23–26
PS1.B Chemical Reactions	Aligned <i>PhD Science</i> Lessons
Chemical reactions that occur when some substances are mixed can be identified by the emergence of substances with different properties; the total mass remains the same.	Level 5 M2 L1–2, 9–26
PS2.A Forces and Motion PS2.B Types of Interactions	Aligned <i>PhD Science</i> Lessons
The effect of unbalanced forces on an object results in a change of motion. Some forces act through contact; some forces act even when the objects are not in contact.	Level 3 M4 L1–22, 28–30
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

PS3.A Definitions of Energy		Aligned <i>PhD Science</i> Lessons
PS3.B Conservation of Energy and Energy Transfer		
Moving objects contain energy. The faster the object moves, the more energy it has.		Level 4 M2 L1–9, 12–16, 24–26
Energy can be moved from place to place by moving objects, or through sound, light, or electrical currents.		Level 4 M2 L1–3, 10–11, 15–16, 24–26
Energy can be converted from one form to another form.		Level 4 M2 L10–11, 15–23, 24–26
PS3.C Relationships Between Energy and Forces		Aligned <i>PhD Science</i> Lessons
When objects collide, 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 <i>PhD Science</i> Lessons
Energy can be “produced” or “used” by converting stored energy.		Level 4 M2 L12–14, 24–26
Plants capture energy from sunlight, which can later be used as fuel or food.		Level 5 M2 L6–7, 15–19, 24–26
PS4.A Wave Properties		Aligned <i>PhD Science</i> Lessons
Waves are regular patterns of motion, which can be made in water by disturbing the surface. Waves of the same type can differ in amplitude and wavelength.		Level 4 M3 L7–14, 29–31
Waves can make objects move.		Level 4 M3 L7–14, 29–31
PS4.B Electromagnetic Radiation		Aligned <i>PhD Science</i> Lessons
Objects can be seen when light reflected from their surface enters our eyes.		Level 4 M4 L1–17, 25–27
PS4.C Information Technologies and Instrumentation		Aligned <i>PhD Science</i> Lessons
Patterns can allow information to be encoded, sent, received, and decoded.		Level 4 M4 L18–27

Technology/Engineering

ETS1.A Define Design Problems	Aligned <i>PhD Science</i> Lessons
A possible solution to a simple problem must meet specified criteria and constraints.	Level 3 M1 L21–26 Level 4 M2 L17–23 Level 5 M2 L21–23

ETS1.B Develop Solutions	Aligned <i>PhD Science</i> Lessons
Solutions need to be researched and compared.	Level 3 M2 L22–25 Level 4 M1 L12–17 Level 4 M4 L14–17 Level 5 M2 L21–23 Level 5 M3 L19–23

ETS1.C Optimize Solutions	Aligned <i>PhD Science</i> Lessons
Solutions are improved based on results of simple tests, including failure points.	Level 3 M4 L23–27 Level 4 M1 L12–17 Level 4 M4 L14–17 Level 5 M1 L18–22

Science and Engineering Practices: 3–5

1. Asking Questions and Defining Problems	Aligned <i>PhD Science</i> Lessons
Ask questions about what would happen if a variable is changed.	Level 4 M3 L15–19
Identify scientific (testable) and non-scientific (non-testable) questions.	Level 3 M3 L12–13 Level 3 M4 L15–16, 19–21
Ask questions that can be investigated and predict reasonable outcomes 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 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
Use prior knowledge to describe problems that can be solved.	Level 3 M4 L22, 29–30 Level 5 M3 L19–23
Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.	Level 3 M1 L21–26, 28–29 Level 3 M4 L23–27 Level 4 M1 L12–17 Level 4 M2 L17–23 Level 4 M4 L14–17

2. Developing and Using Models	Aligned <i>PhD Science</i> Lessons
Identify limitations of models.	Level 4 M4 L14–17, 26–27 Level 5 M1 L5–6 Level 5 M2 L14 Level 5 M3 L6–8, 25–27
Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events.	Level 4 M2 L15–16 Level 4 M4 L3–8, 10–13 Level 5 M1 L5–6 Level 5 M2 L1–2, 6–7 Level 5 M4 L1–2, 7–8, 14–17
Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution.	Level 3 M1 L1–3 Level 3 M2 L1–3, 6–8, 27–28 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 and/or use models to describe and/or predict 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 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
Develop a diagram or simple physical prototype to convey a proposed object, tool, or process.	Level 3 M2 L22–25 Level 3 M4 L23–27 Level 4 M4 L26–27
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

3. Planning and Carrying Out Investigations	Aligned <i>PhD Science</i> 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 Level 4 M1 L8–11 Level 4 M2 L6–7 Level 4 M3 L15–19 Level 4 M4 L7–8, 18–21
Evaluate appropriate methods and/or tools for collecting data.	Level 3 M3 L12–13 Level 4 M4 L7–8
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 Level 4 M1 L6–11, 21–22 Level 4 M2 L10–14 Level 4 M3 L15–19 Level 4 M4 L9, 26–27
Make predictions about what would happen if a variable changes.	Level 3 M3 L12–13 Level 3 M4 L7–9, 15–16, 28–30 Level 5 M4 L5–6
Test two different models of the same proposed object, tool, or process to determine which better meets criteria for success.	Level 4 M4 L14–17

4. Analyzing and Interpreting Data	Aligned <i>PhD Science</i> Lessons
Represent data in tables and/or various graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships.	Level 3 M1 L4–12 Level 3 M3 L7–8, 27–28 Level 3 M4 L4–9 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, mathematics, and/or computation.	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 Level 4 M1 L12–20, 23–24, 26–27 Level 4 M2 L25–26 Level 4 M4 L10–13
Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.	Level 3 M3 L14–15, 19–20 Level 3 M4 L7–9 Level 5 M3 L14–16
Analyze data to refine a problem statement or the design of a proposed object, tool, or process.	Level 4 M4 L14–17
Use data to evaluate and refine design solutions.	Level 4 M4 L14–17

5. Using Mathematics and Computational Thinking	Aligned <i>PhD Science</i> Lessons
Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success.	Level 3 M4 L23–27 Level 5 M4 L5–6
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
Describe, measure, estimate, and/or graph quantities such as area, volume, weight, and time to address scientific and engineering questions and problems.	Level 3 M3 L7–8 Level 4 M2 L8–9
Create and/or use graphs and/or charts generated from simple algorithms to compare alternative solutions to an engineering problem.	Level 4 M4 L14–17

6. Constructing Explanations and Designing Solutions	Aligned <i>PhD Science</i> 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 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 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 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 3 M2 L26–28 Level 3 M3 L26–28 Level 3 M4 L28–30 Level 4 M1 L3–5, 10, 18, 21–22, 25–27
Apply scientific ideas to solve design problems.	Level 3 M2 L22–25 Level 3 M4 L28–30 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 3 M1 L21–29 Level 3 M2 L22–25 Level 4 M1 L12–17 Level 4 M4 L14–17, 22–24

7. Engaging in Argument from Evidence	Aligned <i>PhD Science</i> Lessons
Compare and refine arguments based on an evaluation of the evidence presented.	Level 3 M3 L16–18 Level 4 M3 L21–23 Level 4 M4 L7–8
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 Level 4 M3 L21–23, 26–28, 30–31 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
Use data to evaluate claims about cause and effect.	Level 3 M3 L19–20 Level 3 M4 L12–14 Level 5 M4 L24–26
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 3 M1 L21–26, 28–29 Level 3 M2 L20–21 Level 5 M3 L19–23

8. Obtaining, Evaluating, and Communicating Information	Aligned <i>PhD Science</i> 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 Level 4 M1 L3–5 Level 4 M3 L30–31 Level 4 M4 L22–24 Level 5 M2 L10–11, 18–19, 25–26
Compare and/or combine across complex texts and/or other reliable media to support an investigation or design.	Level 3 M2 L13–15 Level 5 M2 L6–7, 20 Level 5 M3 L25–27
Combine information in written text with that contained in corresponding tables, diagrams, and/or charts to support an investigation or design.	Level 5 M4 L18–19
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 Level 4 M1 L3–5, 23–24 Level 4 M3 L4–6, 10–11, 20–23, 26–28 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

Crosscutting Concepts: 3–5

1. Patterns	Aligned <i>PhD Science</i> Lessons
<p>Students can identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and use these patterns to make predictions.</p>	<p>Level 3 M1 L11–15, 19–20, 27–29 Level 3 M3 L1–8, 14–15, 27–28 Level 3 M4 L1–9, 28–30 Level 4 M3 L7–9, 30–31 Level 4 M4 L1–2, 22–27 Level 5 M4 L5–6, 9–17, 20–26</p>
2. Cause and Effect	Aligned <i>PhD Science</i> Lessons
<p>Students can routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.</p>	<p>Level 3 M1 L1–3, 16–18, 21–26, 27–29 Level 3 M2 L9–12, 16–28 Level 3 M3 L9–13, 19–25, 27–28 Level 3 M4 L1–3, 10–30 Level 4 M1 L6–17, 19–27 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 Level 5 M1 L1–2, 5–6, 9–10, 18–22, 24–26 Level 5 M2 L3–7, 12–13, 18–23, 25–26 Level 5 M3 L6–8, 12–18, 25–27 Level 5 M4 L5–6, 24–26</p>
3. Scale, Proportion, and Quantity	Aligned <i>PhD Science</i> Lessons
<p>Students can recognize that natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.</p>	<p>Level 3 M1 L4–10 Level 3 M2 L1–2, 27–28 Level 3 M3 L1–3, 14–15 Level 4 M1 L3–5 Level 5 M1 L3–4, 13–17, 23–26 Level 5 M2 L10–11 Level 5 M3 L1–5, 10–11, 24–27 Level 5 M4 L18–19, 24–26</p>

4. Systems and System Models	Aligned <i>PhD Science</i> Lessons
<p>Students can understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.</p>	<p>Level 3 M1 L1–3, 16–20 Level 3 M2 L6–15, 20–28 Level 3 M3 L9–11 Level 3 M4 L1–30</p> <p>Level 4 M1 L1–2, 12–17, 21–24 Level 4 M2 L1–11, 15–26 Level 4 M3 L7–9, 15–19, 21–23, 26–28, 30–31 Level 4 M4 L1–6, 10–17, 18–27</p> <p>Level 5 M1 L3–4, 15–17 Level 5 M2 L1–2, 6–11, 14, 18–19, 24–26 Level 5 M3 L1–9, 12–13, 19–27 Level 5 M4 L1–2, 6–26</p>
5. Energy and Matter	Aligned <i>PhD Science</i> Lessons
<p>Students can learn that matter is made of particles and energy can be transferred in various ways and between objects. Students observe the conservation of matter by tracking matter flows and cycles before and after processes and recognizing that the total weight of substances does not change.</p>	<p>Level 4 M2 L1–3, 8–26 Level 4 M3 L10–19, 30–31</p> <p>Level 5 M1 L5–8, 13–14, 23–26 Level 5 M2 L6–11, 14, 15–19, 24–26 Level 5 M3 L10–11 Level 5 M4 L3–4</p>
6. Structure and Function	Aligned <i>PhD Science</i> Lessons
<p>Students can learn that different materials have different substructures, which can sometimes be observed, and that substructures have shapes and parts that serve functions.</p>	<p>Level 3 M2 L1–3, 9–12 Level 3 M3 L4–6, 21–28</p> <p>Level 4 M3 L4–5, 20, 24–25 Level 4 M4 L4–6, 7–9, 25–27, 29–31</p>

7. Stability and Change	Aligned <i>PhD Science</i> Lessons
<p>Students can measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some systems appear stable, but over long periods of time they will eventually change.</p>	<p>Level 3 M1 L4–15, 27–29 Level 3 M2 L16–19 Level 3 M3 L7–8, 12–13, 19–20, 26–28 Level 4 M1 L3–11, 18–20, 25–27 Level 5 M1 L1–2, 9–12, 18–26 Level 5 M2 L12–13, 20, 24–26 Level 5 M3 L14–18 Level 5 M4 L5–6, 9–12, 24–26</p>
8. Interdependence of Science, Engineering, and Technology	Aligned <i>PhD Science</i> Lessons
<p>Students can describe how science and technology support each other. Tools and instruments are used to answer scientific questions, while scientific discoveries lead to the development of new technologies.</p>	<p>Level 3 M4 L22–27 Level 5 M4 L7–8</p>
9. Influence of Engineering, Technology, and Science on Society and the Natural World	Aligned <i>PhD Science</i> Lessons
<p>People’s needs and wants change over time, as do their demands for new and improved technologies. Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. When new technologies become available, they can bring about changes in the way people live and interact with one another.</p>	<p>Level 3 M1 L21–26 Level 3 M2 L22–25 Level 3 M4 L22–27 Level 4 M1 L12–17, 23–24 Level 4 M2 L15–23 Level 4 M4 L14–17 Level 5 M2 L21–23 Level 5 M3 L19–23</p>

Understandings About the Nature of Science (Practices): 3–5

Scientific Investigations Use a Variety of Methods	Aligned <i>PhD Science</i> Lessons
Science methods are determined by questions.	Level 3 M4 L1–3 Level 5 M4 L5–6
Science investigations use a variety of methods, tools, and techniques.	Level 3 M4 L15–16 Level 5 M2 L8–9
Scientific Knowledge Is Based on Empirical Evidence	Aligned <i>PhD Science</i> Lessons
Science findings are based on recognizing patterns.	Level 3 M3 L7–8 Level 3 M4 L4–6 Level 4 M3 L7–9 Level 5 M4 L14–15
Scientists use tools and technologies to make accurate measurements and observations.	Level 5 M4 L7–8
Scientific Knowledge Is Open to Revision in Light of New Evidence	Aligned <i>PhD Science</i> Lessons
Science explanations can change based on new evidence.	Level 5 M4 L14–15
Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena	Aligned <i>PhD Science</i> Lessons
Science theories are based on a body of evidence and many tests.	Level 3 M4 L12–14
Science explanations describe the mechanisms for natural events.	Level 5 M2 L14 Level 5 M4 L1–2, 7–8, 13
Science Is a Way of Knowing	Aligned <i>PhD Science</i> Lessons
Science is both a body of knowledge and processes that add new knowledge.	Level 5 M3 L6–8
Science is a way of knowing that is used by many people.	Level 3 M3 L16–18

Scientific Knowledge Assumes an Order and Consistency in Natural Systems	Aligned <i>PhD Science</i> Lessons
Science assumes consistent patterns in natural systems.	Level 3 M2 L4–5 Level 4 M1 L6–7 Level 5 M1 L7–8
Basic laws of nature are the same everywhere in the universe.	Level 5 M4 L9–12, 16–17

Science Is a Human Endeavor	Aligned <i>PhD Science</i> Lessons
Men and women from all cultures and backgrounds choose careers as scientists and engineers.	Level 3 M3 L16–18
Most scientists and engineers work in teams.	Level 3 M3 L12–13 Level 4 M2 L17–23
Science affects everyday life.	Level 3 M1 L21–26 Level 4 M2 L1–3
Creativity and imagination are important to science.	Level 5 M3 L19–23

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