K-8 Nature of Science/Inquiry Learning Expectations[1]
Public Schools of Brookline (2010)

Topic	K-2 Skills[2]	3-5 Skills[2]	6-8 Skills
Science as a Human Endeavor			
What is Science and Why is It Important?	• Give examples, in their own words or using pictures, describing what science is and how it is important to them	• Give examples, in their own words, describing what science is and how it is important to them	• Give examples of what science is, how it applies in real-world contexts, and how it is important to them • Examine local problems that involve science and brainstorm solutions and ways that they can help be part of the solution
What are Scientists Like and Where Do They Work?	• Think of themselves as scientists • As a group, record details about different scientists (why they decided to become a scientist, what their work is like, and what they most enjoy about their work) from information gathered during scientist class visits and reading about scientists of different backgrounds and gender. [1st Grade, 2nd Grade]	• Think of themselves as scientists • Record details about the different characteristics of scientists (why they decided to become a scientist, what their work is like, and what they most enjoy about their work) from information gathered during scientist class visits and reading about scientists of different backgrounds and gender	• Think of themselves as scientists • Record and compare the characteristics of scientists (why they decided to become a scientist, what their work is like, and what they most enjoy about their work) from information gathered during scientist class visits and reading about scientists of different backgrounds and gender
	• Give examples, in their own words or using pictures, to describe some of the places that scientists work and why	• Give examples of some of the places that scientists work and explain why • Explain what scientists do in the various disciplines of science (e.g., biology, geology, physics, astronomy, etc.)	• Explain what scientists do in the various disciplines of science (e.g., biology, geology, physics, astronomy, etc.) and where they work • Participate in visits to local facilities where science is practiced and/or participate in a class discussion with community individuals, who work in science-related occupations • Investigate scientific resources/projects taking place in the Brookline/Boston community • Use a variety of resources (e.g., books, films guest scientists, field trips) to report and discuss the variety of opportunities for practicing science
	• Work collaboratively with others in small teams to make observations, ask questions about their observations, and sort living and nonliving things • Share information in small groups (e.g., listening, encouraging each other, sharing observations) [1st Grade, 2nd Grade]	• Work collaboratively with others in small teams to make observations, ask questions about their observations, design investigations and analyze results • Share information in small groups (e.g., listening, encouraging each other, sharing observations)	• Work collaboratively with others in small teams to design, conduct, and analyze (compare and question) results of investigations • Share information in small groups (e.g., listening, encouraging each other, sharing observations)
Does Science Change?	-----	• Give examples of the contributions made in science by individuals of diverse backgrounds throughout history and in the present day • Explain several instances throughout history and in the present day in which scientific conclusions have changed as new evidence or tools have become available • Share current events about science and new discoveries	• Give examples of the contributions made in science by individuals of diverse backgrounds throughout history and in the present day • Explain several instances throughout history and in the present day in which scientific conclusions have changed as new evidence or tools have become available • Share current events about science and new discoveries • Using the life stories of scientists, show how perseverance and other individual traits interact with historical context (inc. technology) to advance or obstruct scientific understanding.

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Science as Inquiry: How Do Scientists Learn New Things?			
Asking Questions Why is Curiosity important in Science?	• Be curious and ask questions about their world and how it relates to themselves • Ask questions while observing and exploring a variety of objects, living things, and events in the environment • As a group with the teacher, develop a list of questions raised by the class about what they observe • During group discussions, identify which questions the class is capable of answering or investigating, and talk about how the questions could be answered or investigated	• Be curious and ask questions about their world and how it relates to themselves • Ask questions while observing and exploring a variety of objects, living things, and events in the environment • Determine which questions can be answered or investigated, decide what information is needed to answer the questions, and brainstorm ways to investigate	• Be curious and unafraid to ask questions about their world and how it relates to themselves • Ask questions while observing and exploring a variety of objects, living things, and events in the environment • Determine which questions can be answered or investigated, decide what information is needed to answer the questions, and brainstorm ways to investigate
Making Predictions Why Do Scientists Make Predictions?	• Practice making logical predictions about what the answer to a testable question will be (based on prior knowledge and observations) • Give examples illustrating the differences between a prediction and a "wild guess" • Practice explaining reasons behind their predictions	• Make informed, logical predictions about what the answer to a testable question will be (based on prior knowledge and observations) Explain the reasons behind their predictions • Give examples showing the differences between a prediction and a "wild guess"	• Make informed, logical predictions about what the answer to a testable question will be (based on prior knowledge and observations) • Explain the reasons behind their predictions • Give examples showing the differences between a prediction and a "wild guess" • Explain the difference between a prediction and a hypothesis
Gathering Evidence How Do Scientists Answer Their Questions?	• Actively participate in classroom and group discussions focused on how to answer questions raised by the class or individuals	• Actively participate in classroom and group discussions focused on how to answer questions raised by the class or individuals	• Actively participate in classroom and group discussions focused on how to answer questions raised by the class or individuals • Give examples of the different and ways that scientists gather evidence (there is no fixed set of steps that all scientists follow) • Explain the concept of systems and give examples • Demonstrate an understanding of why systems thinking can be very useful in science
	• Use a variety of reference materials (books and other sources of information) to collect information to answer their questions • Describe why it is important to use information from reliable sources • Explain the difference between fiction and nonfiction	• Use a variety of reference materials (books and other sources of information) to collect information to answer questions • Describe why it is important to use information from reliable sources • Think critically about all information and be able to determine if it is reliable or not	• Use a variety of reference materials (books and other sources of information) to collect information to answer questions and support investigations • Describe why it is important to use information from reliable sources • Think critically about all information and be able to determine if it is reliable or not
	• Observe, draw and verbally describe (with guidance) different types of objects & living things, identifying basic properties (e.g., color, shape,	• Describe observations (objects, living things and natural occurrences) verbally and in their science notebooks using drawings, text, photographs,	• Describe observations (objects, living things and natural occurrences) verbally and in science notebooks using drawings, text, photographs, artifacts, etc.

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	texture, hardness, etc.) [Kindergarten] • Describe observations (objects, living things and natural occurrences) verbally and in science notebooks using words, pictures, diagrams, photographs, and/or artifacts [1st Grade, 2nd Grade] • Explain which body part would be used to gather information (e.g., "to find out if a ball is soft, I would use my hand; to find out what color it is, I would use my eyes.") [Kindergarten] • Observe and draw objects and living things from the top, bottom, front and back—noticing how it may look different from different views [1st Grade, 2nd Grade] • Ask questions about observations that could lead to further investigations (e.g., what would happen if we….?)	artifacts, etc. • Observe and draw objects and living things from the top, bottom, front and back—noticing how it may look different from different views • Ask questions about observations that could lead to further investigations (e.g., what would happen if we….?) • Give examples of the difference between an observation and an inference (and why it is important to know the difference)	• Ask questions about observations that could lead to further investigations (e.g., what would happen if we….?) • Give examples of the difference between an observation and an inference (and why it is important to know the difference) • Make quantitative and quantitative observations
	• Answer questions by planning and conducting simple investigations using simple tools [1st Grade, 2nd Grade] • Select and use materials to carry out investigations	• Plan and conduct simple, multi-step investigations designed to answer testable questions and test predictions. • Select and use materials to carry out investigations • Explain the importance of designing "fair tests" (i.e., keeping all but the condition being tested constant) [4th Grade, 5th Grade] • As a class, critique several examples of investigations to determine if they are "fair" [4th Grade, 5th Grade]	• Create a hypothesis • Explain (with examples) the difference between independent and dependent variables and the importance of variables • Design and conduct an experiment specifying variables to be changed, controlled, and measured
	• Separate a set of objects or living things into two groups based on a single physical attribute in their own way (1st Grade and 2nd Grade: do this multiple times with the same set of objects/living things, sorting on different features) • Arrange a set of objects in sequence according to size [1st Grade, 2nd Grade] • Predict an unseen member in a sequence of objects to complete a pattern [1st Grade, 2nd Grade]	• Classify several types of nonliving things, living things or events and explain why, with teacher support	• Classify several types of nonliving things, living things or events and explain the classification scheme • Explain why classification is important in science
	• Construct scale models, dioramas and maps [2nd	• Construct scale models, dioramas and maps	• Create clear, well-labeled models

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	grade]	• Explain why and how scientists create and use models	• Explain why and how scientists create and use models
Recording Evidence How Do Scientists Collect and Record Their Evidence?	• Participate in classroom discussions about different ways that data from observations and investigations could be recorded • Actively participate in classroom discussions organizing data into simple charts, graphs, or tables that are easy to understand [Kindergarten] • Organize data into simple charts, graphs or tables that are easy for others to understand [1st Grade, 2nd grade]	• Participate in classroom discussions about different ways that data from observations and investigations could be recorded • Organize data in charts, graphs, tables, and diagrams that are easy for others to understand • Give examples of how the same data or information can be organized in many different ways and explain why there is no one "right" way	• Participate in classroom discussions about different ways that data from observations and investigations could be recorded • Organize data in charts, graphs, tables, and diagrams that are easy for others to understand • Give examples of how the same data or information can be organized in many different ways and explain why there is no one "right" way
	• Record observations, questions, and predictions in a science notebook using words, pictures, diagrams, photographs and/or artifacts • Include a date or date stamp on each notebook entry and labels and titles when appropriate • Create notebook entries that are accurate, complete and understandable [1st Grade, 2nd Grade]	• Record observations, questions, predictions, evidence, claims (based on their evidence) and conclusions in a science notebook using words, pictures, diagrams, photographs and/or artifacts • Include a date on each notebook entry and labels and titles when appropriate • Create notebook entries that are accurate, neat, complete and understandable	• Record observations, questions, predictions, evidence, claims (based on their evidence) and conclusions in a science notebook using words, pictures, diagrams, photographs and/or artifacts • Include a date on each notebook entry and labels and titles when appropriate • Create notebook entries that are accurate, neat, complete and understandable
	• Begin to distinguish between drawing scientifically (for information) and creatively (for pleasure) • Draw scientifically, including true color, lines, shapes and labels to the best of each child's ability [Kindergarten] • Draw scientifically, including accurate, clear drawings that include labels and a title [1st Grade, 2nd Grade]	• Draw scientifically, including accurate, clear drawings that include labels and a title	• Draw scientifically, including accurate, clear drawings that include labels and a title
Making Claims Based on Evidence How Do Scientists Explain Their Findings Based on Their Evidence?	• Practice using information gathered during observations and simple investigations (evidence) to create a simple, reasonable explanation using their own words (as a group) [Kindergarten] • Use information gathered during observations and simple investigations (evidence) to create a simple, reasonable explanation using their own words [1st Grade, 2nd Grade] • Explain how the evidence is related to the question and/or the big idea	• Explain why all good scientific explanations (claims) must be based on evidence • Give examples of claims that are not based on strong evidence • Use evidence (information gathered during observations and investigations) to create a claim (simple, reasonable explanation) using their own words • Explain how the evidence is related to the question and/or the big idea	• Explain why all good scientific explanations (claims) must be based on evidence • Give examples of claims that are not based on strong evidence • Use evidence (information gathered during observations and investigations) to create a claim (simple, reasonable explanation) • Explain how the evidence is related to the question and/or the big idea

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	• Participate in class discussions to identify patterns in data presented in tables and graphs, and explain what the information means	• Identify patterns in data presented in tables and graphs, and explain what the information means, with teacher support	• Make inferences based on patterns and trends in data presented in tables and graphs, and explain what the information means
	• Share ideas with others in small groups and listen to the ideas of others respectfully	• Share ideas with others in small groups and listen to the ideas of others respectfully	• Share their ideas with others in small groups and listen to the ideas of others respectfully
nterpreting Results & Reflecting on What We .earned What Do cientists Do When Things Don't Turn Out As Expected?	• Participate in class discussions to describe examples of investigations that may not turn out as expected and talk about how this often happens to professional scientists • Give examples (as a group) of what scientists do when their investigations do not turn out as expected • As a group, generate additional questions to investigate following class investigations that do not go as planned	• Explain and give examples of the difference between evidence and conclusions • Draw conclusions that answer the following questions: 1) does your evidence support your prediction? (if not, why), 2) how would you change your thinking based on the evidence? 3) what did you learn that was new? • Give examples of what they might do if the results of their investigation do not turn out as expected. • Reflect on their work and learning following an investigation by writing a reflection in their science notebook that answers the following questions: 1) what other things did you wonder about? 2) are there any new questions you have about your investigation or next steps you want to take?	• Explain and give examples of the difference between evidence and conclusions • Draw conclusions based on evidence that answer the following questions: 1) does your evidence support your prediction? (if not, why), 2) how would you change your thinking based on the evidence? 3) what did you learn that was new? • Give examples of how investigations may not turn out as expected and what they might do in these situations • Reflect on their work and learning by writing a reflection in their science notebook that answers the following questions: 1) what other things did you wonder about? 2) are there any new questions you have about your investigation or next steps you want to take? • Analyze where the uncertainties lie and/or difficulties controlling an experiment originated, and generate questions and alternative procedures for further study.
:ommunicating t Collaborating)o Scientists lways Agree?	• Communicate questions, observations, experiences, and thinking in a variety of ways (e.g., verbally and in science notebooks) • Actively participate in small group conversations and classroom discussions to share their experiences and ideas [1st Grade, 2nd Grade] • Construct scale models, dioramas and maps to communicate scientific knowledge [2nd grade]	• Communicate questions, observations, experiences, and thinking in a variety of ways to a variety of audiences using notebooks, graphs, charts, maps, and oral and written reports. • Actively participate in small group conversations and classroom discussions to share their experiences and ideas • Construct scale models, dioramas and maps to communicate scientific knowledge	• Communicate questions, observations, experiences, and thinking in a variety of ways using notebooks, graphs, charts, maps, and oral and written reports. • Actively participate in small group conversations and classroom discussions to share their experiences and ideas • Construct scale models, maps, and appropriately labeled diagrams to communicate scientific knowledge • Explain how their knowledge connects to the knowledge of other people, other subjects and the world beyond the classroom
	• Compare their observations and data with what other students have discovered • If there are differences in what students observe, discuss possible explanations (in whole group with teacher) • Be open minded and willing to consider differing	• Compare their observations, investigation methods, and data with what other students have discovered • If there are differences in what students observe, discuss possible explanations (in whole group with teacher) • With the class, discuss and give examples of how	• Compare their observations, investigation methods, and data with what other students have discovered • Discuss the use of different methods, materials, etc. to answer the same question • Recognize and analyze alternative explanations for the same set of data

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	ideas	different methods, materials, etc. can be used to answer the same question • Be open minded and willing to consider differing ideas	• Be open minded and willing to consider differing ideas • Give examples of scientific controversies throughout history and in the world today
	• Listen to and respect the ideas proposed by other students • Read simple tables and graphs produced by others and describe in words what they mean [2nd Grade] • Ask questions about other students' work and ideas, share ideas for improvement or other ways of studying a problem [2nd Grade]	• Listen to and respect the ideas proposed by other students • Read tables and graphs produced by others and describe in words what they mean • Ask questions about other students' work and ideas, share ideas for improvement or other ways of studying a problem	• Listen to and respect the ideas proposed by other students • Read tables and graphs produced by others and describe what they mean • Ask questions about other students' work and ideas, share ideas for improvement or other ways of studying a problem • Evaluate the strengths and weaknesses of claims, arguments and data presented by others • Be skeptical of arguments based on very small samples of data, biased samples, or samples for which there was no control sample • Actively participate in monthly "Lab Meetings" in which students share their work and discuss for group feedback • Read with understanding articles about science in the popular press and engage in discussions about the validity of the conclusions
Using Scientific Tools & Technology What Types of Tools and Skills Do Scientists Use?	• Use tools (such as jewelers loupes, magnifiers, thermometers, balances, rulers, and measuring cups) to collect information to answer questions • Use appropriate unites of measure (nonstandard units) [Kindergarten] • Use appropriate units of measure (metric and English units) [1st Grade, 2nd Grade] • Give examples explaining how the use of tools helps us extend our senses and/or find out something more precisely • Use computers to research answers to questions, record information and communicate ideas and findings	• Demonstrate increasing sophistication in using tools to collect information to answer their questions • Select and use appropriate tools to gather, analyze and interpret data • Use appropriate units of measure (metric and English units) • Use computers to research answers to questions, record information and communicate ideas and findings	• Demonstrate increasing sophistication in using tools to collect information to answer their questions • Use appropriate units of measure (metric and English units) • Use computers to research answers to their questions, record information and communicate their ideas and findings • Select and use appropriate tools to gather, analyze and interpret data • Read analog and digital meters on instruments used to measure length, volume, weight, elapsed time, rates and temperature. Be able to choose appropriate reporting units. • Find and describe locations on maps using appropriate coordinates
	• Listen to and/or read, and compare a variety of fiction and nonfiction books that focus on science topics or scientists • Interpret nonfiction text, diagrams, and photographs to determine essential information [1st Grade, 2nd Grade] • Begin to develop strategies and skills for	• Read and compare a variety of science texts including fiction and nonfiction books, including books about scientists and their work • Interpret nonfiction text, diagrams, and photographs to determine essential information • Develop strategies and skills for information gathering	• Read and compare a variety of science texts including fiction and nonfiction books, including books about scientists and their work • Interpret nonfiction text, diagrams, and photographs to determine essential information • Develop strategies and skills for information gathering • Use math, reading, writing, drawing and technology when doing investigations and communicating their results

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	information gathering [Kindergarten] • Develop strategies and skills for information gathering [1st Grade, 2nd Grade] • Give examples of skills that they (student scientists) are using to do science	• Use math, reading, writing, drawing and technology when doing investigations and communicating results	
Safety & Use of Resources How Do Scientists Work Safely?	• Demonstrate safe use of all materials and tools in class and on field trips • Explain using pictures or words why it is important to conserve resources and reuse materials when appropriate • Give examples of ways that scientists respect living things and treat them humanely	• Demonstrate safe use of all materials and tools in class and on field trips • Explain why it is important to conserve resources and reuse materials when appropriate • Give examples of ways that scientists respect living things and treat them humanely	• Demonstrate safe use of all materials and tools in class and on field trips • Explain why it is important to conserve resources and reuse materials when appropriate • Give examples of how scientists respect living things and treat them humanely • Explain relevant safety rules and what to do in the case of an emergency
Science Vocabulary Why Do Scientists Use Science Words in Their Work?	• Use an age-appropriate science vocabulary from a word wall with understanding • Use (with understanding) age-appropriate science vocabulary in everyday speaking, listening and writing	• Use (with understanding) age-appropriate science vocabulary in everyday speaking, listening and writing	• Use (with understanding) age-appropriate science vocabulary into their everyday speaking, listening and writing
The Nature of Science/Inquiry Learning Expectations are important skills that teach students what science is all about, how scientists work, and the tools/skills that they use. These skills should be embedded in all Science instruction and some should be practiced each time Science is taught. When appropriate, skills tailored to specific grade levels are noted in brackets.			