

Science Standard Articulated by Grade Level Strand 1: Inquiry Process

Concept 1: Observations, Questions, and Hypotheses Observe, ask questions, and make predictions.				
Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
PO 1. Observe common objects using multiple senses.	PO 1. Compare common objects using multiple senses.	PO 1. Formulate relevant questions about the properties of objects, organisms, and events in the environment. (See M02-S2C1-01)	PO 1. Formulate relevant questions about the properties of objects, organisms, and events of the environment using observations and prior knowledge. (See M03-S2C1-01)	PO 1. Differentiate inferences from observations.
PO 2. Ask questions based on experiences with objects, organisms, and events in the environment. (See M00-S2C1-01)	<i>PO 2. Ask questions based on experiences with objects, organisms, and events in the environment. (See M01-S2C1-01)</i>	PO 2. Predict the results of an investigation (e.g., in animal life cycles, phases of matter, the water cycle).	PO 2. Predict the results of an investigation based on observed patterns, not random guessing.	PO 2. Formulate a relevant question through observations that can be tested by an investigation. (See M04-S2C1-01)
PO 3. Predict results of an investigation based on life, physical, and Earth and space sciences (e.g., the five senses, changes in weather).	<i>PO 3. Predict results of an investigation based on life, physical, and Earth and space sciences (e.g., animal life cycles, physical properties, Earth materials).</i>			PO 3. Formulate predictions in the realm of science based on observed cause and effect relationships.
				PO 4. Locate information (e.g., book, article, website) related to an investigation. (See W04-S3C6-01 and R04-S3C1-05)

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Arizona Department of Education - Standards Based Teaching and Learning

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Science Standard Articulated by Grade Level
Strand 1: Inquiry Process

Concept 1: Observations, Questions, and Hypotheses			
Formulate predictions, questions, or hypotheses based on observations. Locate appropriate resources.			
Grade 5	Grade 6	Grade 7	Grade 8
<i>PO 1. Formulate a relevant question through observations that can be tested by an investigation. (See M05-S2C1-01)</i>	PO 1. Differentiate among a question, hypothesis, and prediction.	<i>PO 1. Formulate questions based on observations that lead to the development of a hypothesis. (See M07-S2C1-01)</i>	<i>PO 1. Formulate questions based on observations that lead to the development of a hypothesis. (See M08-S2C1-01)</i>
<i>PO 2. Formulate predictions in the realm of science based on observed cause and effect relationships.</i>	PO 2. Formulate questions based on observations that lead to the development of a hypothesis. (See M06-S2C1-01)	PO 2. Select appropriate resources for background information related to a question, for use in the design of a controlled investigation. (See W07-S3C6-01 and R07-S3C1-06)	PO 2. Use appropriate research information, not limited to a single source, to use in the development of a testable hypothesis. (See W08-S3C6-01 and R08-S3C2-03)
<i>PO 3. Locate information (e.g., book, article, website) related to an investigation. (See W05-S3C6-01 and R05-S3C1-05)</i>	PO 3. Locate research information, not limited to a single source, for use in the design of a controlled investigation. (See W06-S3C6-01 and R06-S3C1-06)	PO 3. Explain the role of a hypothesis in a scientific inquiry.	PO 3. Generate a hypothesis that can be tested.

Concept 1: Observations, Questions, and Hypotheses
Formulate predictions, questions, or hypotheses based on observations. Evaluate appropriate resources.
High School
PO 1. Evaluate scientific information for relevance to a given problem. (See R09-S3C1, R10-S3C1, R11-S3C1, R12-S3C1)
PO 2. Develop questions from observations that transition into testable hypotheses.
PO 3. Formulate a testable hypothesis.
PO 4. Predict the outcome of an investigation based on prior evidence, probability, and/or modeling (not guessing or inferring).

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Science Standard Articulated by Grade Level
Strand 1: Inquiry Process

Concept 2: Scientific Testing (Investigating and Modeling)				
Participate in planning and conducting investigations, and recording data.				
Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
PO 1. Demonstrate safe behavior and appropriate procedures (e.g., use of instruments, materials, organisms) in all science inquiry.	<i>PO 1. Demonstrate safe behavior and appropriate procedures (e.g., use of instruments, materials, organisms) in all science inquiry.</i>	<i>PO 1. Demonstrate safe behavior and appropriate procedures (e.g., use of instruments, materials, organisms) in all science inquiry.</i>	<i>PO 1. Demonstrate safe behavior and appropriate procedures (e.g., use of instruments, materials, organisms) in all science inquiry.</i>	<i>PO 1. Demonstrate safe behavior and appropriate procedures (e.g., use and care of technology, materials, organisms) in all science inquiry.</i>
PO 2. Participate in guided investigations in life, physical, and Earth and space sciences.	<i>PO 2. Participate in guided investigations in life, physical, and Earth and space sciences.</i>	<i>PO 2. Participate in guided investigations in life, physical, and Earth and space sciences.</i>	PO 2. Plan a simple investigation (e.g., one plant receives adequate water, one receives too much water, and one receives too little water) based on the formulated questions.	PO 2. Plan a simple investigation that identifies the variables to be controlled.
PO 3. Perform simple measurements using non-standard units of measure to collect data.	PO 3. Use simple tools such as rulers, thermometers, magnifiers, and balances to collect data (U.S. customary units). (See M01-S4C4-07)	<i>PO 3. Use simple tools such as rulers, thermometers, magnifiers, and balances to collect data (U.S. customary units). (See M02-S4C4-05 and M02-S4C4-06)</i>	PO 3. Conduct simple investigations (e.g., related to plant life cycles, changing the pitch of a sound, properties of rocks) in life, physical, and Earth and space sciences.	PO 3. Conduct controlled investigations (e.g., related to erosion, plant life cycles, weather, magnetism) in life, physical, and Earth and space sciences.
	PO 4. Record data from guided investigations in an organized and appropriate format (e.g., lab book, log, notebook, chart paper). (See W01-S3C2-01 and W01-S3C3-01)	<i>PO 4. Record data from guided investigations in an organized and appropriate format (e.g., lab book, log, notebook, chart paper). (See W02-S3C2-01 and W02-S3C3-01)</i>	PO 4. Use metric and U.S. customary units to measure objects. (See M03-S4C4-04)	PO 4. Measure using appropriate tools (e.g., ruler, scale, balance) and units of measure (i.e., metric, U.S. customary). (See M04-S4C4-03 and M04-S4C4-07)

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Concept 2: Scientific Testing (Investigating and Modeling)				
Participate in planning and conducting investigations, and recording data.				
Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
			PO 5. Record data in an organized and appropriate format (e.g., t-chart, table, list, written log). (See W03-S3C2-01 and W03-S3C3-01)	<i>PO 5. Record data in an organized and appropriate format (e.g., t-chart, table, list, written log). (See W04-S3C2-01 and W04-S3C3-01)</i>

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Science Standard Articulated by Grade Level
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Concept 2: Scientific Testing (Investigating and Modeling)			
Design and conduct controlled investigations.			
Grade 5	Grade 6	Grade 7	Grade 8
<i>PO 1. Demonstrate safe behavior and appropriate procedures (e.g., use and care of technology, materials, organisms) in all science inquiry.</i>	<i>PO 1. Demonstrate safe behavior and appropriate procedures (e.g., use and care of technology, materials, organisms) in all science inquiry.</i>	<i>PO 1. Demonstrate safe behavior and appropriate procedures (e.g., use and care of technology, materials, organisms) in all science inquiry.</i>	<i>PO 1. Demonstrate safe behavior and appropriate procedures (e.g., use and care of technology, materials, organisms) in all science inquiry.</i>
<i>PO 2. Plan a simple investigation that identifies the variables to be controlled.</i>	PO 2. Design an investigation to test individual variables using scientific processes.	<i>PO 2. Design an investigation to test individual variables using scientific processes.</i>	PO 2. Design a controlled investigation to support or reject a hypothesis.
PO 3. Conduct simple investigations (e.g., related to forces and motion, Earth processes) based on student-developed questions in life, physical, and Earth and space sciences.	PO 3. Conduct a controlled investigation using scientific processes.	PO 3. Conduct a controlled investigation, utilizing multiple trials, to test a hypothesis using scientific processes.	PO 3. Conduct a controlled investigation to support or reject a hypothesis.
<i>PO 4. Measure using appropriate tools (e.g., ruler, scale, balance) and units of measure (i.e., metric, U.S. customary).</i> (See M05-S4C4-01)	PO 4. Perform measurements using appropriate scientific tools (e.g., balances, microscopes, probes, micrometers). (See M06-S4C4-02)	<i>PO 4. Perform measurements using appropriate scientific tools (e.g., balances, microscopes, probes, micrometers).</i>	<i>PO 4. Perform measurements using appropriate scientific tools (e.g., balances, microscopes, probes, micrometers).</i>
<i>PO 5. Record data in an organized and appropriate format (e.g., t-chart, table, list, written log).</i> (See W05-S3C2-01 and W05-S3C3-01)	PO 5. Keep a record of observations, notes, sketches, questions, and ideas using tools such as written and/or computer logs. (See W06-S3C2-01 and W06-S3C3-01)	<i>PO 5. Keep a record of observations, notes, sketches, questions, and ideas using tools such as written and/or computer logs.</i> (See W07-S3C2-01 and W07-S3C3-01)	<i>PO 5. Keep a record of observations, notes, sketches, questions, and ideas using tools such as written and/or computer logs.</i> (See W08-S3C2-01 and W08-S3C3-01)

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Concept 2: Scientific Testing (Investigating and Modeling) Design and conduct controlled investigations.
High School
PO 1. Demonstrate safe and ethical procedures (e.g., use and care of technology, materials, organisms) and behavior in all science inquiry.
PO 2. Identify the resources needed to conduct an investigation.
PO 3. Design an appropriate protocol (written plan of action) for testing a hypothesis: <ul style="list-style-type: none">• Identify dependent and independent variables in a controlled investigation.• Determine an appropriate method for data collection (e.g., using balances, thermometers, microscopes, spectrophotometer, using qualitative changes).• Determine an appropriate method for recording data (e.g., notes, sketches, photographs, videos, journals (logs), charts, computers/calculators).
PO 4. Conduct a scientific investigation that is based on a research design.
PO 5. Record observations, notes, sketches, questions, and ideas using tools such as journals, charts, graphs, and computers.

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Concept 3: Analysis and Conclusions Organize and analyze data; compare to predictions.				
Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
PO 1. Organize (e.g., compare, classify, and sequence) objects, organisms, and events according to various characteristics. (See M00-S4C4-01 and M00-S4C4-03)	<i>PO 1. Organize (e.g., compare, classify, and sequence) objects, organisms, and events according to various characteristics.</i> (See M01-S4C4-01)	PO 1. Organize data using graphs (i.e., pictograph, tally chart), tables, and journals. (See M02-S2C1-02)	PO 1. Organize data using the following methods with appropriate labels: <ul style="list-style-type: none"> • bar graphs • pictographs • tally charts (See M03-S2C1-02)	PO 1. Analyze data obtained in a scientific investigation to identify trends. (See M04-S2C1-03)
PO 2. Compare objects according to their measurable characteristics (e.g., longer/shorter, lighter/heavier). (See M00-S4C4-01)	PO 2. Compare the results of the investigation to predictions made prior to the investigation.	PO 2. Construct reasonable explanations of observations on the basis of data obtained (e.g., Based on the data, does this make sense? Could this really happen?). (See M02-S2C1-04)	PO 2. Construct reasonable interpretations of the collected data based on formulated questions. (See M03-S2C1-03)	PO 2. Formulate conclusions based upon identified trends in data. (See M04-S2C1-03)
		PO 3. Compare the results of the investigation to predictions made prior to the investigation.	<i>PO 3. Compare the results of the investigation to predictions made prior to the investigation.</i>	PO 3. Determine that data collected is consistent with the formulated question.
		PO 4. Generate questions for possible future investigations based on the conclusions of the investigation.	<i>PO 4. Generate questions for possible future investigations based on the conclusions of the investigation.</i>	PO 4. Determine whether the data supports the prediction for an investigation.

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Concept 3: Analysis and Conclusions Organize and analyze data; compare to predictions.				
Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
			PO 5. Record questions for further inquiry based on the conclusions of the investigation.	PO 5. Develop new questions and predictions based upon the data collected in the investigation.

Concept 3: Analysis and Conclusions Analyze and interpret data to explain correlations and results; formulate new questions.			
Grade 5	Grade 6	Grade 7	Grade 8
PO 1. Analyze data obtained in a scientific investigation to identify trends and form conclusions. (See M05-S2C1-03)	PO 1. Analyze data obtained in a scientific investigation to identify trends. (See M06-S2C1-03)	<i>PO 1. Analyze data obtained in a scientific investigation to identify trends.</i> (See M07-S2C1-07 and M07-S2C1-08)	<i>PO 1. Analyze data obtained in a scientific investigation to identify trends.</i> (See M08-S2C1-08)
PO 2. Analyze whether the data is consistent with the proposed explanation that motivated the investigation.	PO 2. Form a logical argument about a correlation between variables or sequence of events (e.g., construct a cause-and-effect chain that explains a sequence of events).	<i>PO 2. Form a logical argument about a correlation between variables or sequence of events (e.g., construct a cause-and-effect chain that explains a sequence of events).</i>	<i>PO 2. Form a logical argument about a correlation between variables or sequence of events (e.g., construct a cause-and-effect chain that explains a sequence of events).</i>
PO 3. Evaluate the reasonableness of the outcome of an investigation.	PO 3. Evaluate the observations and data reported by others.	PO 3. Analyze results of data collection in order to accept or reject the hypothesis.	PO 3. Interpret data that show a variety of possible relationships between two variables, including: <ul style="list-style-type: none"> • positive relationship • negative relationship • no relationship
PO 4. Develop new investigations and predictions based on questions that arise from the findings of an investigation.	PO 4. Interpret simple tables and graphs produced by others.	PO 4. Determine validity and reliability of results of an investigation.	PO 4. Formulate a future investigation based on the data collected.

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Concept 3: Analysis and Conclusions			
Analyze and interpret data to explain correlations and results; formulate new questions.			
Grade 5	Grade 6	Grade 7	Grade 8
PO 5. Identify possible relationships between variables in simple investigations (e.g., time and distance; incline and mass of object).	PO 5. Analyze the results from previous and/or similar investigations to verify the results of the current investigation.	PO 5. Formulate a conclusion based on data analysis.	PO 5. Explain how evidence supports the validity and reliability of a conclusion.
	PO 6. Formulate new questions based on the results of a completed investigation.	PO 6. Refine hypotheses based on results from investigations.	PO 6. Identify the potential investigational error that may occur (e.g., flawed investigational design, inaccurate measurement, computational errors, unethical reporting).
		PO 7. Formulate new questions based on the results of a previous investigation.	PO 7. Critique scientific reports from periodicals, television, or other media.
			<i>PO 8. Formulate new questions based on the results of a previous investigation.</i>

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Concept 3: Analysis, Conclusions, and Refinements

Evaluate experimental design, analyze data to explain results and to propose further investigations. Design models.

High School

PO 1. Interpret data that show a variety of possible relationships between variables, including:

- *positive relationship*
- *negative relationship*
- *no relationship*

PO 2. Evaluate whether investigational data support or do not support the proposed hypothesis.

PO 3. Critique reports of scientific studies (e.g., published papers, student reports).

PO 4. Evaluate the design of an investigation to identify possible sources of procedural error, including:

- sample size
- trials
- controls
- analyses

PO 5. Design models (conceptual or physical) of the following to represent "real world" scenarios:

- carbon cycle
- water cycle
- phase change
- collisions

PO 6. Use descriptive statistics to analyze data, including:

- mean
- frequency
- range

(See MHS-S2C1-10)

PO 7. Propose further investigations based on the findings of a conducted investigation.

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Concept 4: Communication Communicate results of investigations.				
Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
PO 1. Communicate observations with pictographs, pictures, models, and/or words. (See M00-S2C1-02)	PO 1. Communicate the results of an investigation using pictures, graphs, models, and/or words. (See M01-S2C1-02 and W01-S3C2-02)	PO 1. Communicate the results and conclusions of an investigation (e.g., verbal, drawn, or written). (See M02-S2C1-02 and W02-S3C2-02)	PO 1. Communicate investigations and explanations using evidence and appropriate terminology. (See W03-S3C2-01)	PO 1. Communicate verbally or in writing the results of an inquiry. (See W04-S3C3-01)
PO 2. Communicate with other groups to describe the results of an investigation. (See LS-R3 and LS-R5)	<i>PO 2. Communicate with other groups to describe the results of an investigation. (See LS-F1)</i>	<i>PO 2. Communicate with other groups to describe the results of an investigation. (See LS-F1)</i>	PO 2. Describe an investigation in ways that enable others to repeat it. (See W03-S3C3-01 and LS-F1)	PO 2. Choose an appropriate graphic representation for collected data: <ul style="list-style-type: none"> • bar graph • line graph • Venn diagram • model (See M04-S2C1-02)
			<i>PO 3. Communicate with other groups to describe the results of an investigation. (See LS-E1)</i>	PO 3. Communicate with other groups or individuals to compare the results of a common investigation.

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Concept 4: Communication Communicate results of investigations.			
Grade 5	Grade 6	Grade 7	Grade 8
<i>PO 1. Communicate verbally or in writing the results of an inquiry.</i> (See W05-S3C3-01)	PO 1. Choose an appropriate graphic representation for collected data: <ul style="list-style-type: none"> • line graph • double bar graph • stem and leaf plot • histogram (See M06-S2C1-02)	PO 1. <i>Choose an appropriate graphic representation for collected data:</i> <ul style="list-style-type: none"> • <i>line graph</i> • <i>double bar graph</i> • <i>stem and leaf plot</i> • <i>histogram</i> (See M07-S2C1-03)	PO 1. Communicate the results of an investigation.
<i>PO 2. Choose an appropriate graphic representation for collected data:</i> <ul style="list-style-type: none"> • <i>bar graph</i> • <i>line graph</i> • <i>Venn diagram</i> • <i>model</i> (See M05-S2C1-02)	PO 2. Display data collected from a controlled investigation. (See M06-S2C1-02)	<i>PO 2. Display data collected from a controlled investigation.</i> (See M07-S2C1-03)	<i>PO 2. Choose an appropriate graphic representation for collected data:</i> <ul style="list-style-type: none"> • <i>line graph</i> • <i>double bar graph</i> • <i>stem and leaf plot</i> • <i>histogram</i> (See M08-S2C1-03)
<i>PO 3. Communicate with other groups or individuals to compare the results of a common investigation.</i>	PO 3. Communicate the results of an investigation with appropriate use of qualitative and quantitative information. (See W06-S3C2-01)	<i>PO 3. Communicate the results of an investigation with appropriate use of qualitative and quantitative information.</i> (See W07-S3C2-01)	PO 3. Present analyses and conclusions in clear, concise formats. (See W08-S3C6-02)
	PO 4. Create a list of instructions that others can follow in carrying out a procedure (without the use of personal pronouns). (See W06-S3C3-01)	PO 4. Write clear, step-by-step instructions for following procedures (without the use of personal pronouns). (See W07-S3C3-01)	PO 4. Write clear, step-by-step instructions for conducting investigations or operating equipment (without the use of personal pronouns). (See W08-S3C3-01)
	PO 5. Communicate the results and conclusion of the investigation. (See W06-S3C6-02)	<i>PO 5. Communicate the results and conclusion of the investigation.</i> (See W07-S3C6-02)	<i>PO 5. Communicate the results and conclusion of the investigation.</i> (See W08-S3C6-02)

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Concept 4: Communication

Communicate results of investigations.

High School

PO 1. For a specific investigation, choose an appropriate method for communicating the results. (See W09-S3C2-01 and W10-S3C2-01)

PO 2. Produce graphs that communicate data. (See MHS-S2C1-02)

PO 3. Communicate results clearly and logically.

PO 4. Support conclusions with logical scientific arguments.

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