

Scientific Practices Optimized for Teachers (SPOT)
ASKING QUESTIONS

Indicator	Focus of Observation			
Make Observations What did I observe?	Student	Makes statements focused on a direct observation.	Makes statements connecting between prior knowledge, experiences, or information and direct observations.	Makes statements about expected and unexpected observations.
	Teacher	Provides guiding statements that encourage deeper observations and questions. <i>"I notice..." "I wonder..."</i>	Frames and creates opportunities for students to connect to prior knowledge or experiences <i>"It reminds me of..."</i>	Provides a model for further investigation to promote expected and unexpected observations <i>"I wonder what would happen if..."</i>
Formulate Questions What do I want to know about what I observed?	Student	Distinguishes between testable and non-testable questions related to the observations.	Formulates testable questions that can be investigated.	Formulates testable questions and revises non-testable questions.
	Teacher	Asks students, "what questions do you have?" After making lists of questions, ask students to classify types of questions after providing clear explanation of testable vs. non-testable	Frames the problem/activity in a way that focuses on creating testable questions that can be investigated in class. "Based on what you observed, what new questions are you thinking about?"	Models how to change non-testable into testable and giving instruction. "What are some testable questions we could investigate as a follow-up to our observations?" "Is it possible to change these non-testable questions into testable questions?"
Make Predictions or Hypotheses What do I predict will happen?	Student	Makes a prediction directly related to the testable question and the observable phenomena	Makes a prediction that includes why it might happen	Makes a hypothesis that includes the relationship between variables and whether this is a reasonable prediction.
	Teacher	Models/Prompts students about direct observation <i>"I think..."</i>	Models/Prompts students to think about their prediction and to explain their reasoning. <i>"If I do..., what do you predict will happen? Why?"</i>	Models/Prompts students to identify relationships, provide explanations, and to think about the reasonableness of the hypothesis. <i>"You hypothesized this will happen because this changes or occurs... Why?" "Do you think your prediction seems possible based on what you already know? Why or why not?"</i>

Scientific Practices Optimized for Teachers (SPOT)
PLANNING AND CARRYING OUT INVESTIGATIONS

Indicator	Focus of Observation			
Design a Fair Test How can I make a fair test?	Student	Designs an investigation testing a single variable.	Designs a fair test investigation with multiple controlled variables and multiple trials.	Evaluates and redesigns a fair test investigation with multiple controlled variables and multiple trials.
	Teacher	Models how to design an investigation with one variable	Models how to design a fair test investigation with multiple controlled variables.	Provides students with the procedures of an investigation and asks them to revise it to make it a fair test and to conduct the investigation
Identify and Evaluate Tools What are the best tools to use in my experiment?	Student	Selects appropriate tool(s) from a choice of tools to gather data and supports their choice with reasoning	Identifies the appropriate tool(s) to gather data and supports choice with reasoning and clear explanation	Evaluates the possible tools and explains why they selected the specific tool(s) for the investigation.
	Teacher	Provides students with a choice of tools and explains each tool's specific uses. <i>"I will use this tool because..."</i>	Provides tools and asks students to select the appropriate tool for the investigation and to give reasons. <i>"This tool is better than any other because..."</i>	Asks students to evaluate the appropriateness of the tool selected for the investigation. <i>"This tool is the best for this investigation because..."</i>
Collect and Evaluate Data What is the best data to collect to answer my testable question?	Student	Collects relevant data using the method given by teacher	Collects data and explains the fit between the data collected and the testable question.	Evaluates the appropriateness of the data to answer the testable question and collects relevant data.
	Teacher	Demonstrates a specific method of collecting data and explains the rationale	Asks students about the best fit data to answer the research question, and to share their reasoning. <i>"For this investigation, I will need to collect to answer my question because...."</i>	Allows students to identify and evaluate the possible data to be collected and explain why the data they selected is the best fit for the investigation. <i>"I will collect.....to answer my testable questionit is the best fit.....because....."</i>

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ANALYZING AND INTERPRETING DATA

Indicator	Focus of Observation			
Display Data How do I use tables or graphs (bar graphs, pictographs, or pie charts) to display data?	Student	Completes table or graph provided by teacher or curriculum.	Creates a graph with support, enters data, and accurately labels the graph or table.	Selects an appropriate method to display data, enters data, and accurately labels the graph.
	Teacher	Demonstrates how to accurately label and construct graphs or tables and models how to enter data.	Models how to create and accurate label a graph or table, and how to enter data.	Models how to choose an appropriate method to display data, how to accurate label and enter data.
Identify Patterns and Relationships How do I identify patterns and relationships between the variables?	Student	Identifies patterns in the data with support from teacher.	Identifies and describes the relationships between variables OR the patterns within the data.	Identifies and explains the relationships between the variables AND the patterns within the data.
	Teacher	Using sample tables or graphs, teacher models how to examine the data and to identify patterns within the data.	Models and asks students to identify patterns in the data OR relationships between variables. “What patterns do you see in the graph?” “When ____ (variable) goes down, what happens to ____ (another variable)_?”	Models and asks students to explain relationships between variables and patterns within the data. “What is the relationship between ____ and ____ when you examine the graph?”
Compare Multiple Data How do I identify the similarities and differences in our class data?	Student	States the similarities and differences that they notice using sentence frames provided by teacher.	Compares and contrasts findings and asks questions about the similarities and differences in the data.	Compares and contrasts findings. Asks question and come up with possible explanations for the similarities and differences in data.
	Teacher	Draws students’ attention to similarities and differences in data collected by the whole class. “Groups _ and _ data is because.....” “Groups _ and ____ have different”	Models questioning similarities and differences in sets of data. Provides question starters: “I wonder...?” “Could it be...?” “Why...?” “What caused...?”	Models explaining student thinking: “I think the difference between ____ and ____ was caused by...” “The reason for A being different from B is...”

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CONSTRUCTING EXPLANATIONS

Indicator	Focus of Observation			
<p>Develop an Explanation</p> <p>How can I develop explanations based on an observed phenomenon?</p>	Student	Develops an explanation using observations and sentence frames provided by the teacher.	Develops an explanation and supports it using their own observations.	Develops an explanation and discusses the strength of the observations used to support the explanation.
	Teacher	Models supported v. non-supported ways to develop an explanation based on observations.	Models and prompts students with questions and sentence frames to develop an explanation based on their observations. “How do you know?” “I think..... because I observed.....”	Models and prompts students with questions and sentence frames to develop explanations and to evaluate the strength of the observations used to support their explanations.
<p>Use Data</p> <p>How can I develop scientific explanations using data?</p>	Student	Answers teacher’s open-ended questions using the data.	Develops explanations supported by data.	Develops and supports explanations making specific references to data patterns or relationships between variables.
	Teacher	Asks questions “ <i>Why do you think more scored...?</i> ”	Prompts students with questions and sentence frames “ <i>Does the data support that explanation?</i> ”	Prompts students to analyze and observe patterns, trends, categories, etc. “I notice that.....”
<p>Identify Evidence</p> <p>How can I identify evidence that supports an explanation?</p>	Student	Identify fact (supported) vs. opinion (non-supported)	Identifies the evidence used to support an explanation.	Discusses the strength of the evidence to determine whether it supports an explanation.
	Teacher	Models process using examples. Direct instruction.	Provides students with examples of strong evidence used to support an explanation. Provides opportunities for students to select evidence to support an explanation.	Prompts students to identify and evaluate the evidence used to support an explanation.

**Scientific Practices Optimized for Teachers (SPOT)
ENGAGING IN ARGUMENT FROM EVIDENCE**

Indicator	Focus of Observation			
<p>Develop an Argument</p> <p>How can I develop and support an argument with evidence, data, and/or model?</p>	Student	Develops a scientific argument using evidence and sentence frame provided by teacher.	Develops a scientific argument based on evidence, data, and/or a model.	Develops and supports a scientific argument citing evidence, data, and/or model.
	Teacher	Models and provides students with evidence and sentence frames.	Models and directs students to develop and support their argument with specific evidence. <i>"I think ___ because <u>specific evidence</u>."</i>	Models the process and discusses the strength of the evidence, data and/or model. <i>"I think ___ because <u>specific evidence</u> and supports the argument with additional evidence."</i>
<p>Evaluate Arguments</p> <p>How can I evaluate arguments based on the strengths and weaknesses of evidence?</p>	Student	Identifies weak v. strong evidence for an argument.	Revises weak arguments using evidence to develop a stronger argument.	Evaluates the strengths and weaknesses of the evidence and revise the argument.
	Teacher	Models and provides students with evidence to compare.	Models and provides students with examples of arguments with varying-strengthened evidence	Models and provides students with opportunities to evaluate different kinds of evidence and to revise their argument based on the strength of the evidence. <i>"At first I thought __, but now I think ___ because ___"</i>
<p>Critique Arguments of Others</p> <p>How can we engage collaboratively and productively to critique the arguments of others?</p>	Student	Responds to teacher-led critiques	Listens to different students' arguments and agrees or disagrees based on whether the argument is supported by evidence. Class provides critique and asks questions with teacher guidance.	Shares arguments with each other in whole class or small group and provides critique by explaining why they agree/disagree with evidence, and pose questions about quality/reliability of evidence
	Teacher	Models critiques of other people's scientific arguments. Asks students to determine if critique was respectful and to pose questions.	Creates safe environment and provides guidelines on how to listen and give critique to classmates. Provide sentence frames. <i>"I agree that your argument is supported by the data"</i> . OR <i>"I hear your argument, but I thought the evidence was indicating___"</i> .	Provides sentence frames. <i>"I agree with your argument because _____"</i> . <i>"I disagree with your argument because _____"</i> . <i>"How did you think about _____ when you created your argument?"</i> Creates safe environment.