Secondary Practices Matrix for PESTL

Science and Engineering Practices – Secondary				
Student Science Practices	**A. Understanding Scientific Explanations**	**B. Generating Scientific Evidence**	**C. Reflecting on Scientific Knowledge**	**D. Participating Productively in Science**
1. Asking Questions (Science) and Defining Problems (Engineering)	A. Identify questions relevant to science or engineering problems. B. Distinguish between science questions and nonscience questions. C. Ask questions that arise from phenomena, models, theory, or unexpected results. D. Pose questions that are testable.	E. Formulate testable hypotheses and pose questions in science that seek evidence relevant to the question. F. Ask questions that require relevant empirical evidence. G. Ask questions to determine relationships between independent and dependent variables. H. Ask questions to clarify or identify the premise(s) of an argument.	I. Consider the scope of the questions posed. J. Ask questions to refine a model, an explanation, or an engineering problem. K. Ask questions that challenge the premise of an argument and/or the interpretation of data.	L. Write science questions that others understand. M. Work collaboratively to develop science questions. N. Ask relevant questions to increase understanding of others.
2. Developing and Using Models	A. Distinguish between representation and the actual object and/or phenomena represented in a model. B. Relate useful models to simple phenomena. C. Make sense of representations that describe phenomena.	D. Use representations to generate evidence. E. Compare evidence generated to accepted science models. F. Use and/or construct models to predict, explain, and/or collect data to test ideas about phenomena in natural or designed systems. G. Pose models to describe mechanisms at unobservable scales. H. Examine merits and limitations of various models.	I. Describe ways to use models to reflect on science concepts or ideas. J. Use representations to reflect on mechanisms of how things work. K. Reflect on ways to modify models to improve their efficiency. L. Reflect on the components of models of simple systems with uncertain and less predictable factors.	M. Share science concepts and understanding with others using representations. N. Share science findings in written and graphic presentations to others. O. Use multiple types of models to represent and explain phenomena to others.
3. Planning and Carrying Out Investigations	A. Describe how science investigations contribute to science explanations. B. Use questions to make sense of the design of an investigation or experiment.	C. Make careful observations that generate evidence. D. Plan and design investigations that generate empirical evidence. E. Recognize patterns in observations and data. F. Plan and carry out investigations and/or test design solutions in a safe and ethical manner. G. Select appropriate tools to collect, record, analyze, and evaluate data. H. Collect data and generate evidence to answer scientific questions or test design solutions under a range of conditions.	I. Consider multiple ways of making observations. J. Reflect on the way data is collected and consider the accuracy of data. K. Evaluate various methods of collecting data. L. Consider possible confounding variables or effects and ensure the investigation's design has controlled for them. M. Reflect on the accuracy of various methods for collecting data.	N. Discuss and compare observations with others observing the same events. O. Collaborate with others to develop science investigations. P. Seek information and ideas from others doing similar investigations. Q. Work collaboratively in science investigations.
4. Analyzing and Interpreting Data	A. Compare data to make sense of and explain phenomena. B. Use data to define an operational range for a design solution. C. Make sense of graphical displays (e.g., maps) of large data sets to identify temporal and spatial relationships.	D. Compare data and use comparisons as evidence. E. Use mean, median, mode, and variability to analyze and characterize data. F. Use graphical displays to analyze data in order to identify linear and nonlinear relationships. G. Distinguish between causal and correlational relationships. H. Use tools, technologies, and/or models (e.g., computational, mathematical) to generate and analyze data in order to make valid and reliable scientific claims or determine the best design solution for a problem.	I. Reflect on data in light of others' data about similar investigations. J. Consider limitations of data analysis, such as measurement error, and seek to improve precision and accuracy of data with better technological tools and methods such as multiple trials. K. Evaluate the impact of new data on a working explanation of a phenomenon or design solution.	L. Analyze and share findings. M. Consider limitations (e.g., measurement error, sample selection) when analyzing and interpreting data. N. Determine function fits to data, including slope, intercept, and correlation coefficient for linear fits.

5. Using Mathematics and Computational Thinking	A. Use mathematics to compare explanations and understand scale. B. Use mathematical or algorithmic representations of phenomena to make sense of phenomena or solutions to problems.	C. Make and use measurements as evidence. D. Compare evidence from measurements. E. Use mathematical thinking and/or computational outcomes to compare alternative solutions to an engineering problem. F. Use mathematical expressions to represent phenomena to support explanations. G. Use probability and/or statistics to support explanations or arguments.	H. Reflect on the accuracy of measurements. I. Analyze simple data sets for patterns that suggest relationships. J. Use statistical and mathematical techniques, data displays, tables, and/or graphs to find patterns and/or relationships in data.	K. Share findings with others using data presented in tables, charts, and graphs. L. Use simple-limit cases to test mathematical expressions, computer programs or algorithms, or simulations to see if a model "makes sense" by comparing the outcomes with what is known about the real world.
6. Constructing Explanations (Science) and Designing Solutions (Engineering)	A. Describe the evidence supporting a valid explanation. B. Compare multiple explanations of the same science phenomenon. C. Evaluate attributes of explanations from models or representations. D. Revise causal explanations that are supported by data and relate these explanations to current knowledge.	E. Explain science observations using evidence. F. Design a solution to a problem and use evidence to compare the advantages of the design to other solutions. G. Use patterns as evidence to support explanations. H. Apply scientific reasoning to link evidence to explanations. I. Base explanations on evidence and the assumption that natural laws operate today as they did in the past and will continue to do so in the future. J. Use qualitative and quantitative relationships between variables to construct explanations for phenomena.	K. Evaluate multiple explanations for a science phenomenon. L. Describe the role of evidence in science explanations. M. Base casual explanations on valid and reliable empirical evidence from multiple sources and the assumption that natural laws operate today as they did in the past and will continue to do so in the future. N. Reflect on the best evidence to support a specific explanation.	O. Share explanations with others. P. Work collaboratively to construct science explanations and design solutions. Q. Communicate quantitative claims regarding the relationship between dependent and independent variables. R. Share explanations and arguments based on evidence obtained from a variety of sources (e.g., scientific principles, models, theories) and peer review.
7. Engaging in Argument from Evidence	A. Determine the best evidence supporting an argument. B. Relate the role of science explanation to science arguments. C. Use models to understand arguments. D. Compare multiple arguments based on the strengths and weaknesses of the evidence supporting the argument.	E. Use evidence to generate or support explanations. F. Use evidence to support arguments about science explanations for phenomena. G. Use evidence to support and justify ideas. H. Construct causal explanations of phenomena using evidence and logic.	I. Reflect on the best evidence supporting an explanation. J. Relate the role of science explanations to arguments. K. Respectfully provide and receive critique on scientific arguments. L. Reflect on and revise arguments and design solutions in light of new evidence.	M. Listen and make sense of others' explanations. N. Evaluate and share the sources of information used to support arguments. O. Debate the merits of competing arguments, models, or design solutions. P. Evaluate the evidence and reasoning for arguments supporting currently accepted explanations. Q. Evaluate and share weaknesses in one's own arguments and collaborate to seek better evidence.
8. Obtaining, Evaluating, and Communicating Information	A. Read and understand science information from multiple sources. B. Read critically using scientific knowledge and reasoning to evaluate data, hypotheses, conclusions, and competing information. C. Obtain information reliable sources.	D. Describe information gathered from multiple sources. E. Use appropriate terminology and descriptions. F. Gather and share information using many forms of communication G. Generate and communicate ideas using scientific language and reasoning. H. Gather information from appropriate sources and evaluate the credibility and possible bias of the source and methods used.	I. Identify multiple sources of information. J. Compare science information from multiple sources. K. Reflect on the claims, methods, and designs that appear in scientific and technical texts or media reports.	L. Share science information with others through written, oral, and multimedia reports and presentations. M. Critically read primary scientific literature adapted for classroom use to identify evidence and evaluate the validity and reliability of the claims, methods, and designs. N. Produce written texts, models, and/or oral discourse to communicate ideas.