Coding Robots alignment with NGSS Scientific and Engineering Practice –

DCI Arrangements of the Next Generation Science Standards

https://www.nextgenscience.org/glossary/disciplinary-core-idea-dci

https://www.nextgenscience.org/sites/default/files/NGSS%20DCI%20Combined%2011.6.13.pdf

1	**Asking questions / Defining problems.** Begin with a question about a phenomenon and seek to develop theories that can provide explanatory answers to such questions. Formulate empirically answerable Questions.	All lessons
2	**Developing and using models.** Construct and use a wide variety of models and simulations to help develop explanations about natural phenomena. Models make it possible to go beyond observables and imagine a world not yet seen. Models enable predictions of the form "if… then… therefore…" to be made in order to test hypothetical Explanations.	All lessons
3	**Planning and carrying out investigations.** Scientific investigations may be conducted in the field or laboratory. A major practice of scientists is planning and carrying out a systematic investigation, which requires the identification of what is to be recorded and what are to be treated as the dependent and independent variables.	All lessons
4	**Analyzing and interpreting data.** Observations and data collected from investigations are used to test existing theories and explanations or to revise and develop new explanations. Scientists use a range of tools to identify the significant features and patterns in the data.	All lessons
5	**Using mathematics and computational thinking.** In science, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks, such as constructing simulations, statistically analyzing data, and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable predictions of the behavior of physical systems, along with the testing of such Predictions. Statistical techniques are invaluable for assessing the significance of patterns or correlations.	All lessons

6	Constructing explanations	All lessons
7	Engaging in argument from evidence	All lessons
8	Obtaining, evaluating, and communicating information.	All lessons

NGSS Core Disciplinary Ideas: Engineering, Technology & Applications of Science.
ETS1: Engineering Design: How do engineers solve problems?
ETS2: Links among Engineering, Technology, Science & Society

ETS1.A.	**Defining and Delimiting an Engineering Problem** What is a design for? What are the criteria and constraints of a successful solution? The engineering design process begins with the identification of a problem to solve and the specification of clear goals, or criteria, that the final expected end-user of a technology or process, address such things as how the product or system will function (what job it will perform and how), its durability, and its cost. Criteria should be quantifiable whenever possible and stated so that one can tell if a given design meets them. Engineers must contend with a variety of limitations, or constraints, when they engage in design. Constraints, which frame the salient conditions under which the problem must be solved, may be physical, economic, legal, political, social, ethical, aesthetic, or related to time and place. In terms of quantitative measurements, constraints may include limits on cost, size, weight, or performance, for example. And although constraints place restrictions on a design, not all of them are permanent or absolute. The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions (e.g., familiarity with the local climate may rule out certain plants for the school garden).	1.1,1.2, 2.1, 2.2, 2.3, 2.4, 2.5, 3.2, 3.3, 3.4, 3.5, 4.2, 4.3, 4.4, 4.5, 5.2, 5.3, 5.4, 5.5, 6.1, 6.3, 6.4, 6.5, 7.3, 7.4, 7.5, 8.3, 8.4, 8.5, 9.1, 9.3-5
ETS1.B:	Developing Possible Solutions What is the process for developing potential design Solutions? A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. In any case, it is important to be able to communicate and explain solutions to others. Models of all kinds are important for testing solutions, and computers are valuable tools for simulating systems. Simulations are useful for predicting what would happen if various parameters of the model were changed, as well as for making improvements to the model based on peer and leader (e.g., teacher) feedback.	1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 5.1, 5.2, 5.3, 5.4, 5.5, 6.1, 6.2, 6.3, 6.4, 6.5, 7.1, 7.2, 7.3, 7.4, 7.5, 8.1, 8.2, 8.3, 8.4, 8.5, 9.1, 9.3

ETS1.C:	**Optimizing the Design Solution** How can the various proposed design solutions be compared and improved? There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. Comparing different designs could involve running them through the same kinds of tests and systematically recording the results to determine which design performs best. Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. This iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. Once such a suitable solution is determined, it is important to describe that solution, explain how it was developed, and describe the features that make it successful.	2.2, 2.3, 3.1, 3.4, 3.5, 4.4,5.1, 5.2, 5.3, 5.4, 5.5, 6.3,6.4, 6.5, 7.1, 7.2, 7.3, 7.4, 7.5, 8.1, 8.3, 8.4,8.5, 9.3
ETS2.A:	**Interdependence of Science, Engineering, and Technology.** Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. In order to design better technologies, new science may need to be explored (e.g., materials research prompted by desire for better batteries or solar cells, biological questions raised by medical problems). Technologies in turn extend the measurement, exploration, modeling, and computational capacity of scientific investigations.	All lessons
ETS2.B:	**Influence of Engineering, Technology and Science on Society and the Natural World.** All human activity draws on natural resources and has both short- and long-term consequences, positive as well as negative, for the health of both people and the natural environment. The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. Technologies that are beneficial for a certain purpose may later be seen to have impacts (e.g., health-related, environmental) that were not foreseen. In such cases, new regulations on use or new technologies (to mitigate the impacts or eliminate them) may be required.	1.1, 1.2