Scientists and engineers use mathematics and quantitative thinking to representing variables, behaviors, and their relationships. Mathematics is used to create models and simulations; statistically analyze data; and recognize, communicate, and look for relationships with other variables.

Although there are differences in how mathematics and computational thinking are applied in science and in engineering, mathematics often brings these two fields together by enabling engineers to apply the mathematical form of scientific theories and by enabling scientists to use powerful information technologies designed by engineers. Both kinds of professionals can thereby accomplish investigations and analyses and build complex models, which might otherwise be out of the question. (NRC Framework, 2012, p 65)

K-2: Mathematical and computational thinking in K-2 builds on prior experiences and progresses to recognizing that mathematics can be used to describe the natural and designed world(s).
• Use counting and numbers to identify and describe patterns in the natural and designed world(s).
• Describe, measure, and/or compare the quantitative attributes of different objects and display the data using simple graphs.

3-5: Mathematical and computational thinking in 3-5 builds on K-2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.

• Organize simple data sets to reveal patterns that suggest relationships.

6-8: Mathematical and computational thinking in 6-8 builds on K-5 experiences and progresses to identifying patterns in large datasets and using mathematical concepts to support explanations and arguments.

9-12: Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

• Use digital tools (e.g., computers) to analyze very large datasets for patterns and trends.
  ◦ Use mathematical or computational representations of phenomena to describe explanations. (HS-ESS1- 4)(HS-ESS3- 6)
  ◦ Create a computational model or simulation of phenomena, designed device, process, or system. (HS-ESS3- 3)

**Data Literacy Cubes**

The Data Literacy Cubes can be used to foster mathematics and computational thinking. Cubes are available for analyzing maps, graphs and data. Each type of cube has differentiated questions to scaffold learners in their analysis.
1. Summarize the data.

2. Describe the data.

3. Analyze the data.

4. Assess the data values.

5. Create questions using the data.

6. Apply the data.
Data Cube Questions

1. Summarize the data.
   A. The data are displayed in a (table, chart, etc.) ________.
   B. The title tells me the data are about ________.
   C. The data measure...
   D. The lowest value is ________.
   E. The highest value is ________.

2. Describe the data.
   A. The data were collected using ________ (i.e. thermometer, instrument, etc.).
   B. The data are collected every ________ (day, week, month, quarter, year, etc.).
   C. The unit used to describe the data is ________.

3. Analyze the data.
   A. The geographic area of Earth where the data were collected is ________.
   B. The time range is from ________ to ________.
   C. These data show that ________.

4. Assess the data values.
   A. The mean is ________. The median is ________. The mode is ________.
   B. The highest value is ________. The lowest value is ________.
   C. This variable belongs in the ________ sphere of the Earth System.

5. Create questions using the data.
   A. I wonder ...
   B. If _______ changed, I think the data would (increase/decrease/stay the same) _______.
   C. How does _______? _______.
   D. Why _______?

6. Apply the data.
   A. These data help us understand ________.
   B. These data can explain why ________.
   C. Graph the data.
Data Cube Questions

1. Summarize the data.
   A. The variable is ___________. It represents __________.
   B. The range of the data is from __________ to __________.
   C. The independent variable is ___________. The dependent variable is ___________.

2. Describe the data.
   A. The ___________ instrument collected these data.
   B. The data are collected every ___________. (day, week, month, quarter, year, etc.).
   C. The unit used to describe the data is ___________.

3. Analyze the data.
   A. The geographic area of Earth that is represented is ___________.
   B. The time range is from ___________ to ___________.
   C. This variable belongs in the ___________ sphere of the Earth System.

4. Assess the data values.
   A. The average is ___________. The median is ___________. The mode is ___________.
   B. The measure of central tendency that best represents the data is the ___________. (mean, median or mode). This is because ___________.
   C. The highest value is ___________. The lowest value is ___________.

5. Create questions using the data.
   A. These data make me wonder ___________.
   B. I would like to compare ___________ with these data because ___________.
   C. How do these data affect another sphere in the Earth System?

6. Apply the data.
   A. These data help us understand ___________.
   B. These data can explain the phenomenon of ___________. because ___________.
   C. Technology is related to these data because ___________.
   D. Engineering is connected to these data because ___________.
   E. Graph the data.
Data Cube Questions

1. Summarize the data.
   A. What does the variable represent?
   B. What is the range of the data?
   C. In which sphere of the Earth System does this variable belong?

2. Describe the data.
   A. What instrument/s collected these data?
   B. How frequently were the data collected?
   C. What unit describes the data?

3. Analyze the data.
   A. What geographic area on Earth do the data represent?
   B. What time range do these data represent?
   C. What area and time data would you like to collect to help you analyze these data?

4. Assess the data values.
   A. What is the mean? Median? Mode?
   B. Are there any outliers? If so, what are they? Why don’t they meet your expectations?
   C. Graph the data.

5. Create research questions using the data.
   A. Identify a question related to these data that you could research.
   B. Identify another scientific variable that you could evaluate with these data.
   C. How do you think this area compares to other geographic provinces in your region? (i.e., coastal plain, highlands, etc.)

6. Apply the data.
   A. What science questions do these data help us understand?
   B. Describe how you may use these data to explain a scientific phenomenon.
   C. How is technology connected to these data?
Data Cube Questions

1. Summarize the data.
   A. The data are displayed in a (table, chart, etc.) __________.
   B. The title tells me the data are about __________.
   C. The variable measured is __________.
   D. The lowest value is __________.
   E. The highest value is __________.

2. Describe the data.
   A. The data were collected using __________ (i.e. thermometer, instrument, etc.).
   B. The data are collected every __________ (day, week, month, quarter, year, etc.).
   C. The unit used to describe the data is __________.

3. Analyze the data.
   A. The geographic area of Earth where the data were collected is __________.
   B. The time range is from __________ to __________.
   C. These data show that __________.

4. Assess the data values.
   A. The mean is __________. The median is __________. The mode is __________.
   B. The highest value is __________. The lowest value is __________.
   C. This variable belongs in the __________ sphere of the Earth System.

5. Create questions using the data.
   A. I wonder...
   B. If _____ changed, then the data would (increase/decrease/stay the same) ______.
   C. How does...?
   D. Why...?

6. Apply the data.
   A. These data help us understand __________.
   B. These data can explain why __________ happens.
   C. Technology was used to get these data by __________.