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.
Data Cube

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

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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.

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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 ________.