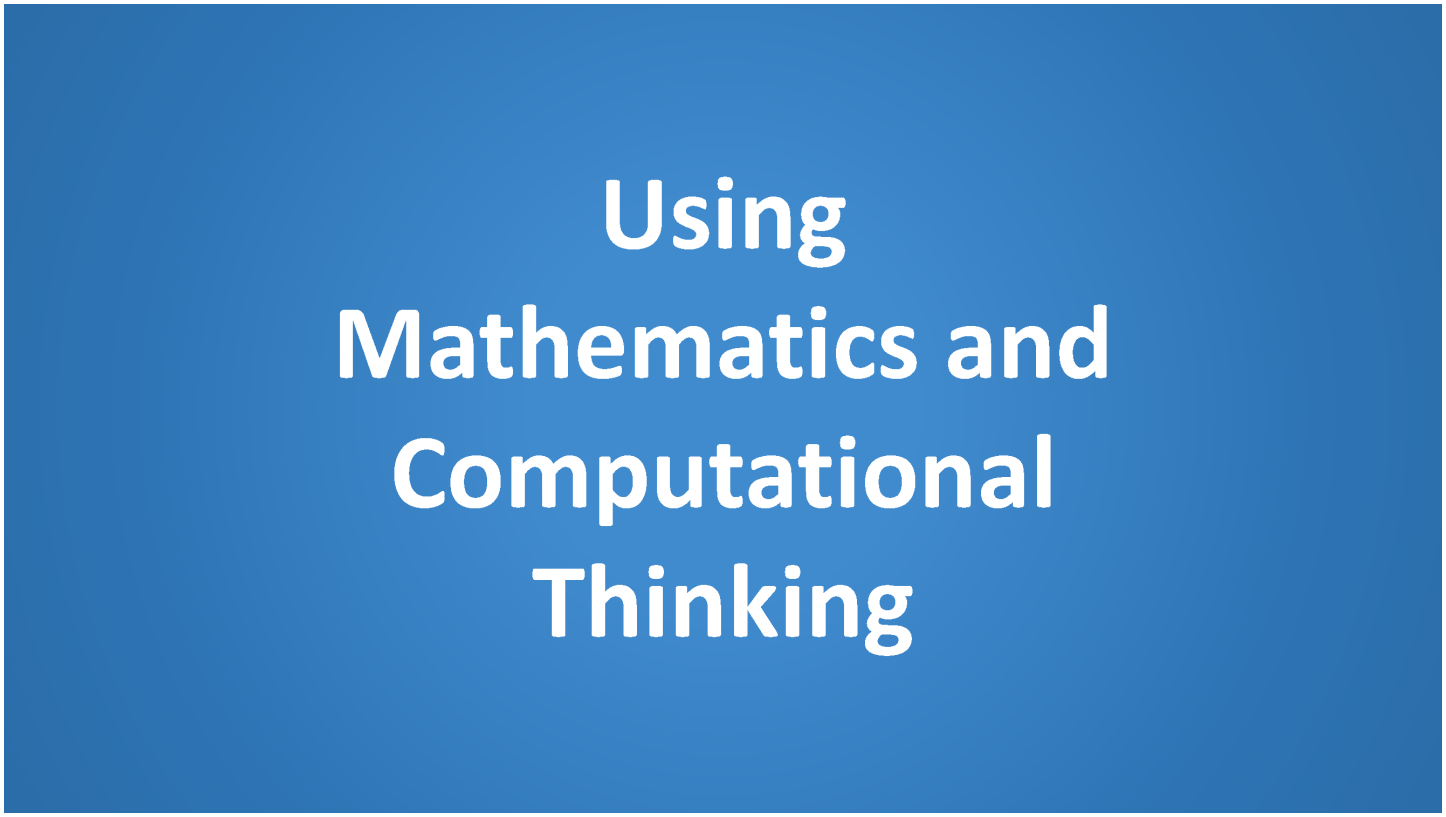
Using Mathematics and Computational Thinking with MND



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.

my NASA data

Data Cube

3. Analyze the data.

Data Cube

2. Describe the data.

Data Cube

4. Assess the data values.

Data Cube

5. Create questions using the data.

my NASA data

Data Cube

6. Apply the data.

Data Cube

NP-2019-04-029-LaRC

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.

A

my NASA data

NP-2019-04-029-LaRC

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.

B

my NASA data

NP-2019-04-029-LaRC

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?

my NASA data

NP-2019-04-029-LaRC

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 _____.

D

my NASA data

NP-2019-04-029-LaRC